AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		4

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0006	06/07/02		

6. ISSUED BY CODE

US ARMY ENGINEER DISTRICT, HONOLULU
CORPS OF ENGINEERS, BUILDING S-200
FORT SHAFTER, HAWAII 96858-5440
CONTRACT SPECIALIST: JODY MURAOKA

7. ADMINISTERED BY (If other than Item 6) CODE

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE FACILITY CODE

(X) **9A. AMENDMENT OF SOLICITATION NO.**

X DACA83-02-R-0004

9B. DATED (SEE ITEM 11)

04/10/02

10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. Accounting and Appropriation Data (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(X)	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc). SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

FY02 DLA MILCON KNMD 003002, Replace Hydrant Fuel System, Hickam Air Force Base, Oahu, HI

(See Page 2 of 2 Pages.)

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF SIGNER (Type or print)	
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)	16C. DATE SIGNED

1. CHANGES TO THE SOLICITATION. Attached hereto are new and revised pages to the solicitation. The revision mark "(Am-0006)" is shown on each new and revised page.

a. REVISED PROVISIONS/CLAUSES/PAGES. Following are revised pages to the solicitation. Changes are indicated in **bold** print. Although the entire sections are being re-issued under Am-0006, only the following pages/paragraphs/provisions/clauses changed in these sections.

Section 00010

Page 00010-1 (SF 1442), Item 13A

Section 00120

Paragraphs 2.4

Section 00900

Page i
Appendix B - Q23 through Q28

Section 01000

Section 02741 – paragraphs: 3.10.3
Section 02749 – paragraphs: 3.10.3
Section 15050 – paragraphs: 2.12.1
Section 15060 – paragraphs: 1.1, 1.2, 2.2.5, 3.2.1
Section 15070 – paragraphs: 3.15
Section 16528 – paragraphs: 1.4.1

b. NEW PAGES. The following pages are added to the solicitation.

Section 00900

Appendix C - Spill Site Management Plan

2. CHANGES TO DRAWINGS.

REVISED DRAWINGS (NOT ISSUED). Following are revisions made to the drawings listed. These drawings will not be issued with this amendment but will be furnished to the successful offeror at the time of award of the contract.

(1) Sheet No. C-7. At Zone G3, change "2" CARBON STEEL" to "2" STAINLESS STEEL".

(2) Sheet No. C-20. At Zone E3, STA 5+12.57, IVP-4, change "TOP EL. 6.94" to "TOP EL. 7.02".

(3) Sheet No. C-21. At Zone F3, STA 7+54.69, HPV-1 , change "TOP EL. 5.40" to "TOP EL. 5.48".

(4) Sheet No. C-22. At Zone C3, STA 12+75, LPD-5, change "TOP EL. 5.97" to "TOP EL. 6.05". At Zone G3, STA 18+15, HPV-2, change "TOP EL. 6.83" to "TOP EL. 6.91".

(5) Sheet No. C-23. At Zone D3, STA 24+00, LPD-6, change "TOP EL. 6.10" to "TOP EL. 6.18".

(6) Sheet No. C-24. At Zone C3, STA 32+25, HPV-3, change "TOP EL. 6.87" to "TOP EL. 6.95". At Zone G3, STA 38+00, LPD-7 change "TOP EL. 7.57" to "TOP EL. 7.65".

(7) Sheet No. C-25. At Zone F3, STA 44+99.87, IVP-1, change "TOP EL. 9.19" to "TOP EL. 9.27".

(8) Sheet No. C-26. At Zone A3, STA 0+50, IVP-1, change "TOP EL. 9.19" to "TOP EL. 9.27". At Zone E3, STA 6+34.12, LPD-7, change "TOP EL. 7.57" to "TOP EL. 7.65".

(9) Sheet No. C-27. At Zone C3, STA 12+09.12, HPV-3, change "TOP EL. 6.87" to "TOP EL. 6.95".

(10) Sheet No. C-28. At Zone C3, STA 21+25, LPD-8, change "TOP EL. 5.76" to "TOP EL. 5.84".

(11) Sheet No. C-29. At Zone D3, STA 32+10, HPV-4, change "TOP EL. 6.97" to "TOP EL. 7.05".

(12) Sheet No. C-30. At Zone E3, STA 43+75, LPD-9, change "TOP EL. 5.57" to "TOP EL. 5.65".

(13) Sheet No. C-31. At Zone F3, STA 52+75, HPV-5, change "TOP EL. 6.97" to "TOP EL. 7.05".

(14) Sheet No. C-35. At Zone B3, STA 18+50, LPD-11, change "TOP EL. 6.98" to "TOP EL. 7.06". At Zone G3, STA 27+00, HPV-7, change "TOP EL. 6.94" to "TOP EL. 7.02".

(15) Sheet No. C-36. At Zone G3, STA 36+10, LPD-12, change "TOP EL. 5.87" to "TOP EL. 5.95".

(16) Sheet No. C-37. At Zone C3, STA 39+70, HPV-8, change "TOP EL. 6.37" to "TOP EL. 6.45". At Zone F3, STA 43+50, LPD-13, change "TOP EL. 6.17" to "TOP EL. 6.25".

(17) Sheet No. C-38. At Zone C3, STA 47+50, HPV-9, change "TOP EL. 7.87" to "TOP EL. 7.95". At Zone G3, STA 53+60.14, IVP-3, change "TOP EL. 7.08" to "TOP EL. 7.16".

(18) Sheet No. C-39. At Zone B3, STA 0+50, IVP-3, change "TOP EL. 7.08" to "TOP EL. 7.16".

(19) Sheet No. C-40. At Zone B3, STA 10+00, HPV-10, change "TOP EL. 7.37" to "TOP EL. 7.45". At Zone D3, STA 13+66, LPD-14, change "TOP EL. 6.99" to "TOP EL. 7.07". At Zone F3, STA 16+00, HPV-11, change "TOP EL. 8.32" to "TOP EL. 8.40".

(20) Sheet No. C-41. At Zone B3, STA 1+00, LPD-15, change "TOP EL. 6.97" to "TOP EL. 7.05".

(21) Sheet No. C-42. At Zone D3, STA 12+18, LPD-16, change "TOP EL. 7.06" to "TOP EL. 7.14". At Zone F3, STA 14+00, HPV-12, change "TOP EL. 6.57" to "TOP EL. 6.65".

(22) Sheet No. C-44. At Zone B3, STA 27+00, HPV-14, change "TOP EL. 6.47" to "TOP EL. 6.55". At Zone D3, STA 31+25, LPD-18, change "TOP EL. 4.67" to "TOP EL. 4.75". At Zone F3, STA 33+80, HPV-1, change "TOP EL. 5.40" to "TOP EL. 5.48".

(23) Sheet No. C-51. Replace all four tables, "NEW HYDRANT PITS", "NEW HIGH POINT VENTS", "NEW LOW POINT DRAINS", and "NEW ISOLATION VALVE PITS" with those attached. The changes raise the top of the traffic rated pits by one (1) inch.

(24) Sheet No. S-31. At Zones C4 and C6, change "2" CROWN (51)" to "3" CROWN (76)" in two places.

(25) Sheet No. M-26. At Zones A4 and D6, change pit depth and spring line depth from "64" (1625) MIN" and "54" (1350) MIN", respectively, to "65" (1650) MIN" and "55" (1400) MIN", respectively, in two places.

(26) Sheet No. M-28. At Zones C3, E3, and H3, change "2" (50) CROWN" to "3" (76) CROWN" in three places.

(27) Sheet No. E-23. At Zone G2, Detail E, add second set of conduits (2 conduits) to detail, one from each side of EPDS station, that stub up 6" (150mm) and are capped. These represent the spare conduit shown in Section 16 on Sheet E-21.

(28) Sheet No. E-42. At Zone Z3, SYSTEM IN "AUTOMATIC" MODE REFUELING CONDITION, operation sequence, add 6 and 7 as follows:

"6. With PDT-5 or PDT-6 sensing differential pressure corresponding to a flow rate of 1200 ± gpm thru the issue venturi and PDT-7 or PDT-8 sensing differential pressure corresponding to a flow rate of less than 40 ± gpm thru the return venturi for a period of 10 seconds, a subsequent pump (third) will be started.

7. With PDT-5 or PDT-6 sensing differential pressure corresponding to a flow rate of 1800 ± gpm thru the issue venturi and PDT-7 or PDT-8 sensing differential pressure corresponding to a flow rate thru the return venturi of less than 700 ± gpm, the lead, second and third fueling pumps will continue to run and BPCV-2 will continue modulating to pass flow as necessary to maintain upstream pressure requirement and no additional control functions will be initiated until system operating conditions change.

A. If PDT-7 or PDT-8 senses a differential pressure corresponding to a flow rate thru the return venturi of greater than 700 ± gpm for 15 seconds, the control system will intitiate control signals to shut down the third fueling pump, leaving the system to operate as described in Paragraph 5."

3. The proposal due date is set for June 20, 2002, 2:00 P.M. , Hawaiian Standard Time.

SOLICITATION, OFFER, AND AWARD (Construction, Alteration, or Repair)	1. SOLICITATION NUMBER	2. TYPE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES
	DACA83-02-R-0004	☐ SEALED BID (IFB) ☒ NEGOTIATED (RFP)	04/10/02	1

IMPORTANT - The "offer" section on the reverse must be fully completed by the offeror.

4. CONTRACT NUMBER	5. REQUISITION/PURCHASE REQUEST NUMBER	6. PROJECT NUMBER

7. ISSUED BY CODE	8. ADDRESS OFFER TO
Contracting Division (CEPOH-CT-C) U.S. Army Engineer District, Honolulu Building 230 Fort Shafter, Hawaii 96858-5440	Contracting Division (CEPOH-CT-C) U.S. Army Engineer District, Honolulu Building 230 Fort Shafter, Oahu, Hawaii 96858-5440 (Deliver hand-carried proposals to Room 115, Building 200, Fort Shafter, Hawaii 96858-5440)

9. FOR INFORMATION CALL ▶	A. NAME	B. TELEPHONE NUMBER (Include area code) (NO COLLECT CALLS)
	Jody Muraoka	(808)438-8575

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying number, date):

Request for Proposals No. DACA83-02-R-0004, FY02 DLA MILCON KNMD 003002, Replace Hydrant Fuel System, Hickam Air Force Base, Oahu, Hawaii

SEE MAIN TABLE OF CONTENTS

11. The Contractor shall begin performance within 7 calendar days and complete it within 710 calendar days after receiving ☐ award, ☒ notice to proceed. This performance period is ☒ mandatory, ☐ negotiable. (See FAR Clause 52.211-10 .)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE PAYMENT BONDS? (If "YES," indicate within how many calendar days after award in Item 12B.)	12B. CALENDAR DAYS
☒ YES ☐ NO	14

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 6 copies to perform the work required are due at the place specified in Item 8 by 2:00 P.M. (hour) local time 06/20/02 (date). If this is a sealed bid solicitation, offers will be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee ☒ is, ☐ is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 120 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

SECTION 00120

PROPOSAL SUBMISSION REQUIREMENTS
AND EVALUATION FACTORS

1.0 GENERAL

1.1. Cost of Preparing Proposals

The Government will not reimburse any Offeror any costs incurred in the preparation and submittal of an offer in response to this solicitation.

1.2. Inquiries

Address all inquiries regarding this Request for Proposals to:

U.S. Army Engineer District, Honolulu
Attn: Ms. Jody Muraoka (CEPOH-CT-C)
Building S-200
Fort Shafter, Hawaii 96858-5440
Phone No. (808) 438-8575
Fax No. (808) 438-8588
E-Mail: jody.muraoka@usace.army.mil

1.3 Submittal of Proposals

Submit proposal packages to the US Army Corps of Engineers ("the Government") as shown in Block 8 of Standard Form 1442.

Proposals received by the Government after the date and time set for receipt of proposals will be handled in accordance with the requirements of Provision "52.215-1, Instructions to Offerors—Competitive Acquisition (May 2001)," subparagraph (c), found in Section 00100.

1.4 Proposal Evaluation

Numerical scores and other point-scoring techniques will not be used in the evaluation process. Each factor or subfactor will be rated on an adjectival rating system. The Government will evaluate offers in accordance with the NON-PRICE EVALUATION FACTORS described in paragraph 2.5 of this section and the offeror's proposed total price.

Offerors are advised that the Government intends to award without discussions. Upon completing the evaluation of all proposals, the Contracting Officer will, in accordance with the provisions of this solicitation and applicable acquisition regulations, proceed to award without discussions. However, if discussions are determined necessary, the Contracting Officer will establish a competitive range and conduct discussions with those Offerors only within the competitive range. Upon conclusion of discussions, if necessary, the Contracting Officer will request final proposal revisions from the Offerors remaining in the competitive range and may, upon receipt of final proposal revisions, proceed to award a contract without further discussions or notice.

1.5 Contract Award

The Government intends to award a contract to the Offeror whose proposal has been determined to represent the best value to the Government, non-price and price factors considered. Award will be made to the Offeror whose proposal has the best non-price evaluation and the lowest price. However, if there is no Offeror meeting both these criteria, the Government intends to implement a "Best Value" process involving a cost-technical tradeoff process. In this case, award may be made to other than the lowest price Offeror or other than the highest non-price-rated Offeror.

2.0 PROPOSAL FORMAT

2.1 General

Proposals shall be submitted in three (3) separate envelopes. All proposal revisions shall be submitted as page replacements with revised text readily identifiable, e.g. bold face print or underlining. Proposal replacement pages shall be clearly marked "REVISED", shall show the date of revision, shall be submitted in the appropriate number of copies (e.g., if four copies of the original page was required, then four copies of the revised page will also be required), and shall be of a different color than the original pages they are to replace.

2.1.1 Volume I, Non-Price Proposal

One envelope shall be clearly marked, "VOLUME I, NON-PRICE PROPOSAL, RFP NO. DACA83-02-R-0004." It shall contain an original and six (6) copies of the items provided in response to the Non-Price Factors listed in paragraph 2.5.

2.1.2 Volume II, Price Proposal

The second envelope shall be clearly marked, "VOLUME II, PRICE PROPOSAL, RFP NO. DACA83-02-R-0004." It shall contain one original and two copies of the Offeror's completed Standard Form (SF) 1442, using a printed copy of the SF 1442 included in this solicitation.

Volume II shall also include the following:

- One original and two copies of Section 00010, Price Proposal Schedule. Indicate whether or not Facilities Capital Cost of Money is included in the Offeror's costs of performing the work. Proposals that state that Facilities Capital Cost of Money is not included, or proposal that do not address Facilities Capital Cost of Money, will be deemed to have waived Facilities Capital Cost of Money.

- Original and two copies of Price Breakdown (See Paragraph 2.6, Volume II, Price Proposal of Section 00120).

- One original and one copy (certified as a true copy) of the Offeror's executed joint venture agreement and identify the size status for each member of the JV (if the Offeror is a joint venture).

- One original and one copy of the Offeror's completed Section 00600, Representations and Certifications, using a printed copy of Section 00600 included in this solicitation.

- One original and one copy of the Offeror's completed, if applicable, SF LLL, Disclosure of Lobbying Activities, using a printed copy of the SF LLL included as Appendix A in Section 00600.

2.1.3 Volume III, Subcontracting Plan (Large Business Concerns)

If the Offeror is a large business concern, the Offeror shall submit a subcontracting plan in accordance with FAR 52.219-9 (See Section 00100, Appendix A for a sample).

The third envelope shall be clearly marked, "VOLUME III, SUBCONTRACTING PLAN, RFP NO. DACA83-02-R-0004." Volume III will not be evaluated or rated. Only the selected Offeror's plan will be reviewed and must be approved prior to award of the contract.

2.1.4 Table of Contents

Proposal volumes shall be tabbed. Each of the proposal volumes shall include a Table of Contents that includes the title of the subject matter discussed therein and the page number where the information can be

found. The volumes shall be organized in the same order described in paragraph 2.4 of this Section. Each evaluation factor and subfactor shall be separately tabbed. Proposals that are not correctly tabbed may be considered non-responsive.

2.2. Proposal Presentation

Proposals shall be prepared in the English language.

Proposals shall completely address the requirements of the RFP. Elaborate format, binders, special reproduction techniques, and the like are not necessary. However, the proposal shall be neatly organized and bound. All pages, except divider tabs, shall be numbered. Except for divider tabs and revisions sheets, as noted above, plain white 8-1/2" x 11" bond shall be used. However, if drawings or other graphics are included, Offerors may reduce them only to the extent that legibility is not lost.

There is no limit to the number of pages in the non-price proposal. Pages may be single or double sided and shall be typed. Type pitch shall be 10 pitch or larger.

Information presented should be organized so as to pertain to only the evaluation factor or subfactor in which section the information is presented. Information pertaining to more than one evaluation factor or subfactor should be repeated in the tab for each factor or subfactor.

2.3 Proposal Content

Proposals shall be in a narrative format, organized and titled so that each section of the proposal follows the order and format of the factors and subfactors set forth below in paragraph 2.5, "VOLUME I, NON-PRICE PROPOSAL".

Any information, presented in a proposal that the Offeror wants safeguarded from disclosure to other parties must be identified and labeled in accordance with the requirements of Provision "52.215-1, Instructions to Offerors—Competitive Acquisition (May 2001)," subparagraph (e), which is found in Section 00100 of this solicitation. The Government will endeavor to honor the restrictions against release requested by Offerors, to the extent permitted under United States law and regulations.

The proposal must set forth full, accurate, and complete information as required by this solicitation. The Government will rely on such information in the award of a contract. By submission of an offer, the Offeror agrees that all items in its proposal (key managerial and technical home office and on-site personnel, subcontractors, material and equipment manufacturers, targets for utilization of eligible SDB concerns, etc.) will be used throughout the duration of the contract and any substitutions of any item will require prior approval of the Contracting Officer.

2.4 Evaluation Factors

All proposals will be evaluated on non-price and price factors. Offerors are required to provide data addressing all stated factors. If an Offeror does not have data relating to a specific factor, it shall be clearly stated. **The Contracting Officer may use discretion in reasonably applying evaluation standards where Offerors provide information to explain or justify deviation from selection criteria listed in the solicitation.** Offers that do not address all factors may be considered non-responsive and may not receive further consideration.

Non-price evaluation factors are listed in descending order of importance. All subfactors within a factor have equal importance. Non-price factors are approximately equal in weight to price.

NON-PRICE FACTORS (Volume I):

Factor I, Key Personnel

Factor II, Past Performance

Subfactor A - Past Performance Ratings

Subfactor B - Customer Satisfaction

Factor III, Past Experience

Factor IV, Small Business Program

Subfactor A - Extent of proposed small business subcontracting participation in the performance of the proposed contract.

Subfactor B - Past performance in complying with Small Business Subcontracting Plan goals.

Subfactor C - Extent of participation of small disadvantaged business (SDB) concerns in the performance of the proposed contract in the authorized North American Industrial Classification System (NAICS) Industry Subsector

PRICE (Volume II)

2.5 Volume I, Non-Price Proposal

Data provided in response to the non-price factors described below shall be included in Volume I, "Non-Price Proposal". All references to Offeror shall include any proposed subcontractors meeting the criteria stated in paragraph 2.5.2.1 below.

2.5.1 Relevant Experience

Relevant experience refers to construction of military Type III hydrant fueling systems (or equivalent commercial aircraft fueling systems), welding of stainless steel pipe, fuel piping (aboveground and underground), and fuel pumping systems and equipment work; computer-based pump control systems; construction of large vertical above ground fuel storage tanks; and the removal, transportation, and disposal of underground fuel storage tanks and associated piping.

If experience is based upon "equivalent commercial aircraft fueling system", the Offeror shall include a comprehensive and detailed analysis, which explains why the Offeror's cited commercial experience is similar or equivalent to actual Type III experience. This analysis shall include a breakdown and discussion of various project elements and technical challenges in a Type III project. The analysis shall compare the Offeror's commercial experience with the benefits of actual Type III experience on each element as well as overall project integration and management issues.

2.5.2 Construction Team

The construction team shall include the key personnel, joint venture partners, subcontractors, outside associates, or consultants identified in the Offeror's proposal.

2.5.2.1 Subcontract Experience/Credentials

Subcontractors may be included as part of the proposed construction team. The Government will consider the past ~~performance and~~ experience of a subcontractor where the prime contractor provides in its proposal, evidence of a binding teaming agreement or other contractual agreement which creates legal responsibility on the part of the subcontractor. However, the level of consideration will depend on the extent to which the proposal demonstrates the subcontractor's commitment to the project and legal accountability. A copy of all written agreements from each proposed subcontractor shall be included in the proposal. Proposed subcontractors that have not provided a contractual agreement may not be considered in the evaluation of the proposal.

Furthermore, if an Offeror intends to use a subcontractor's past experience ~~or performance~~ information to supplement its own, the subcontractor must provide written consent allowing the Government to hold discussions with the Offeror on the subcontractor's ~~performance~~ experience history. A copy of all consents shall be included in the proposal.

If an Offeror is awarded a contract, all subcontractors that are included in the Offeror's proposal and have provided written commitments to perform in the contract shall be used on the contract. Substitution of any subcontractor(s) included in a successful Offeror's proposal must be submitted for review and acceptance by the Contracting Officer prior to the start of any work by that subcontractor. The Contractor is informed that the Government may take up to 30 days to respond. Any delays resulting from this post-award process shall be the responsibility of the contractor and shall not be a basis for any equitable contract adjustment.

2.5.3 Factor I, Key Personnel

Identify the individuals proposed to fill the key positions --project manager, project superintendent, contractor quality control system manager, and system start-up personnel. Provide resumes for each individual. Resumes must support the individual's qualifications to perform in the identified position, including any special skills or experiences deemed worthy of note. Resumes shall include a List of projects completed by the proposed individual. The list shall include contract number, completion date, title, detailed description, and dollar value. Preference will be given to individuals with past relevant experience (see paragraph 2.5.1 above).

If an Offeror is awarded a contract, all individuals that are included in the Offeror's proposal shall be used on the contract. Substitution or addition of any individual(s) not included in a successful Offeror's proposal must be submitted for review and acceptance by the Contracting Officer prior to the start of work by that individual. The Contractor is informed that the Government will be allowed a minimum of 30 days to respond. Any delays resulting from this substitution process shall be the responsibility of the contractor and shall not be a basis for any equitable contract adjustment.

2.5.3.1 Project Manager

The Project Manager shall be responsible for the contractor's overall management and coordination of this contract and shall be the central point of contact with the Government for performance of all work under this contract, including warranty. The Project Manager shall oversee contract accomplishment, administer all instructions, and answer all questions from the Contracting Officer pertaining to the contract during the life of the contract, including the warranty period. The Project Manager shall be responsible for the complete coordination of all work in this contract. The Project Manager will be responsible for ensuring that adequate internal controls and review procedures are followed in order to eliminate conflicts, errors and omissions, and for ensuring that all technical requirements are met. Another individual may be designated to temporarily act for the Project Manager, however, forty-eight (48) hours advance notice in writing of such change shall be requested to the Contracting Officer, and no change shall be made without prior acceptance by the Contracting Officer. The Project Manager shall have no other duties.

The Project Manager shall have a recognized four-year college degree in engineering, related technical field, or business/management, and five years experience in managing and supervising government construction projects of similar size and scope.

2.5.3.2 Project Superintendent

A Project Superintendent shall be assigned to the contract. This individual shall have a minimum of five years experience as a superintendent on Government construction projects similar in size and scope to this contract. The project superintendent shall have overall responsibility for all operations on the jobsite. The superintendent shall have no other duties.

2.5.3.3 Contractor Quality Control System Manager (CQCSM)

The requirements for the CQCSM are defined in Section 01451.

2.5.3.4 System Start Up Personnel

The requirements for the System Start Up Personnel are defined in Section 15899.

2.5.3.5 Evaluation Standards

Outstanding	The proposal includes all requested information for the factor. Each of the proposed key personnel have at least 10 years of experience on Type III hydrant system construction, plus at least 5 years of other relevant experience and are from the Offeror's organization or committed subcontractors.
Above Average	The proposal includes all requested information for the factor. Each of the proposed key personnel have at least 5 years of experience on Type III hydrant system construction, plus at least 5 years of other relevant experience and are from the Offeror's organization or committed subcontractors.
Satisfactory	The proposal includes all requested information for the factor. All proposed key personnel meet the minimum qualification standards described above and are from the Offeror's organization or committed subcontractors.
Marginal	The proposal does not include all of the requested information for the factor. Not all key personnel are identified, or identified personnel do not meet minimum qualification standards. All proposed key personnel are from the Offeror's organization or committed subcontractors.
Unsatisfactory	The proposal does not include all of the requested information for the factor. Not all key personnel are identified and not all identified personnel meet minimum qualification standards.

2.5.4 Factor II, Past Performance

Data provided in support of this factor shall clearly demonstrate the Offeror's ability to meet the requirements of the contract based on his past performance history on relevant projects similar in size and scope to this contract. Only past performance considered relevant to this project will be considered (see paragraph 2.5.1 above).

2.5.4.1 Information Quality

Offerors should submit complete and accurate information. The Government may elect not to request additional information to perform the evaluation.

2.5.4.2 Subfactor A, Past Performance Ratings

For each of the contracts identified in Volume I, Factor III, Experience, indicate the final overall performance rating received. Only performance ratings for the Offeror will be considered. Projects submitted to demonstrate subcontractor experience will not be included in the evaluation of this subfactor. Provide documentation of the indicated rating in this tab. Undocumented performance ratings will not be considered.

2.5.4.2.1 Evaluation Standards

Outstanding	The Offeror has provided projects meeting the criteria for Factor III, Past Experience. Of the projects meeting the criteria for Past Experience (see paragraph 2.5.5), none of the final performance ratings are less than Satisfactory and at least half are Outstanding.
Above Average	The Offeror has provided projects meeting the criteria for Factor III, Past Experience. Of the projects meeting the criteria for Past Experience (see paragraph 2.5.5), none of the final performance ratings are less than Satisfactory and at least half are Above Average.
Satisfactory	The Offeror has provided projects meeting the criteria for Factor III, Past Experience. Of the projects meeting the criteria for Past Experience (see paragraph 2.5.5), none of the final performance ratings are less than Satisfactory.
Marginal	The Offeror has provided projects meeting the criteria for Factor III, Past Experience. Of

	the projects meeting the criteria for Past Experience (see paragraph 2.5.5), none of the final performance ratings are less than Marginal.
Unsatisfactory	The Offeror has provided projects meeting the criteria for Factor III, Past Experience. Of the projects meeting the criteria for Past Experience (see paragraph 2.5.5), at least one received an Unsatisfactory final performance rating, or documented performance ratings were not submitted.
Neutral	Offerors will not be rated favorably or unfavorably if the Offeror does not have a record of relevant past performance. However, an Offeror with no past performance history may be considered less favorably than an Offeror with a favorable past performance history.

2.5.4.3 Subfactor B, Customer Satisfaction

A customer survey sheet is provided at the end of this section as Attachment 2. For each of the contracts identified in Volume I, Factor III, Offerors shall complete Part A. Offerors shall send the partially completed forms to the selected survey respondents for completion of Part B. The respondent shall return completed surveys directly to the Contracting Officer at the following address:

US Army Engineer District, Honolulu
CEPOH-CT-C
Attn: DACA83-02-R-0004, Customer Survey
Bldg. 230
Fort Shafter, HI 96858-5440

Fax: 808-438-8588

Respondents should be requested to return surveys by the closing date of the solicitation. Surveys received directly from offerors will not be considered in the evaluation.

A copy of page 1 of all partially completed survey sheets sent shall be included in this tab. Ensure that the reference number is completed on each survey sheet to correctly match surveys to the projects listed in Factors III.

2.5.4.3.1 Evaluation Standards

Outstanding	Surveys were received for all of the projects listed in Volume I, Factor III. On all surveys received, all of the ratings for questions 2 through 8 were above average or better and at least half of the ratings for question 9 were outstanding.
Above Average	Surveys were received for all of the projects listed in Volume I, Factor III. On all surveys received, none of the ratings for questions 2 through 8 were less than satisfactory and at least half of the ratings for question 9 were above average or better.
Satisfactory	Surveys were received for all of the projects listed in Volume I, Factor III. On all surveys received, none of the ratings for questions 2 through 9 were less than satisfactory.
Marginal	Surveys were not received for all of the projects listed in Volume I, Factor III; and on the surveys received, none of the ratings for questions 2 through 9 were less than satisfactory.
Unsatisfactory	Surveys were not received for all of the projects listed in Volume I, Factor III; and on the surveys received, one or more of the ratings for questions 2 through 9 were less than satisfactory.
Neutral	Offerors will not be rated favorably or unfavorably if the Offeror does not have a record of relevant past performance or information on past performance is not available. However, an Offeror with no past performance history may be considered less favorably than an Offeror with a favorable past performance history.

2.5.5 Factor III, Past Experience

Data provided in support of this factor shall clearly demonstrate the Offeror's ability to meet the requirements of the contract based on his past experience on relevant projects similar in size and scope to this contract (see paragraph 2.5.1). Only experience considered relevant to this project will be considered.

For each of the projects provided in support of this factor, a Project Data Sheet shall be completed. This sheet is included as Attachment 1 to this specification section. All requested information shall be provided. Failure to provide any of the requested data may be cause to eliminate a project from consideration in the evaluation.

2.5.5.1 Past Experience

Offerors shall identify contracts demonstrating relevant experience completed after 1995, or still underway and awarded prior to 2001, in which they were/are the prime contractor.

If the Offeror intends to rely on its joint venture partner's or subcontractor's past experience/~~past performance for the system supplier or tank installation, etc~~., the Offeror shall submit the information shown in Attachment 1 for each ~~subcontractor~~ committed member of the proposed construction team (see also paragraph 2.5.2 and 2.5.2.1 above).

In order to demonstrate the depth of its experience, Offerors may submit data for themselves and their committed construction team members for the same project. However, the submission of data for multiple team members on the same project will only be counted as a single project.

2.5.5.2 Evaluation Standards

Outstanding	The Offeror has provided at least 8 relevant projects meeting the stated criteria.
Above Average	The Offeror has provided at least 6 relevant projects meeting the stated criteria.
Satisfactory	The Offeror has provided at least 4 relevant projects meeting the stated criteria.
Marginal	The Offeror has provided at least 2 relevant projects meeting the stated criteria.
Unsatisfactory	None of the projects provided by the Offeror are relevant or meet the stated criteria.

2.5.6. Factor IV, Small Business Program

Offerors shall submit data that demonstrate its use of Small Business Concerns for Subfactors A and B. Small Business Concerns include small disadvantaged businesses (SDB), women-owned small businesses, HUBZone small businesses, veteran-owned small businesses and service disabled veteran-owned small businesses. Offerors shall submit data that demonstrate its use of SDB's for Subfactor C.

2.5.6.1 Subfactor A - Extent of proposed small business subcontracting participation in the performance of the proposed contract

- If the offeror is submitting a proposal as a joint venture (JV), identify the size status of each member of the JV.

- Identify in terms of dollar value and percentage of the total proposed contract price, the extent of work the offeror will perform as the prime contractor.

- Identify in terms of dollar value and percentage of the total proposed contract price, the work to be subcontracted to small business concerns, SDB concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and if applicable, historically black colleges or universities/minority institutions (HBCU/MI).

2.5.6.1.1 Evaluation Standards

Outstanding	All USACE subcontracting goals are exceeded. Specific SB, SDB and WOSB are identified as subcontractors or team members. Offerors from small business concerns will be given an outstanding rating.
Above Average	All USACE subcontracting goals are at least met and some are exceeded. Specific SB, SDB and WOSB are identified as subcontractors or team members.
Satisfactory	USACE subcontracting goals are met: SB will perform 62 % of the total subcontract value; 10 % of the total subcontract value will go to SDB; 5% of the total subcontract value will go to WOSB. Specific SB, SDB and WOSB are identified as subcontractors or team members.
Marginal	Most of the USACE subcontracting goals are met, specific SB subcontractors or team members are not identified.
Unsatisfactory	None of the USACE subcontracting goals are met and no justification is provided.

2.5.6.2 Subfactor B - Past performance in complying with Small Business Subcontracting Plan goals.

- Provide SF 294's, "Subcontracting Report for Individual Contracts" for projects of similar scope and magnitude.
- Provide information on awards received for outstanding support of the small business program.
- Provide information on any existing or prior mentor-protégé agreements.

2.5.6.2.1 Evaluation Standards

Outstanding	All goals were exceeded, the Offeror has received awards for outstanding support of the small business program, and the Offeror is or has participated in mentor-protégé agreements or other outreach. Offerors from small business concerns will be given an outstanding rating.
Above Average	All goals were met or exceeded and the Offeror is or has participated in mentor-protégé agreements or other outreach.
Satisfactory	All goals were met.
Marginal	Not all goals were met.
Unsatisfactory	No goals were met.

2.5.6.3 Subfactor C - Extent of participation of small disadvantaged business (SDB) concerns in the performance of the proposed contract in the authorized North American Industrial Classification System (NAICS) Industry Subsector.

- The offeror shall provide targets expressed as dollars and percentages of the total contract value, in each of the applicable, authorized NAICS Industry Subsector, for SDB participation by the contractor, including joint venture partners and team members, and a total target for SDB participation by subcontractors. (The authorized NAICS Industry Subsectors as determined by the Department of Commerce are posted at http://www.arnet.gov/References/sdbadjustments.htm.)
- Targets for subcontractors shall be listed separately. The offeror shall provide a listing of the name, address, telephone number, type of work to be performed and target for each SDB subcontractor. Any targets will be incorporated into and become part of the resulting contract.

2.5.6.3.1 Evaluation Standards

Outstanding	SDB participation targets in each of the applicable, authorized NAICS Industry Subsector are provided. Targets are challenging. Specific SDB concerns are identified.

Above Average	SDB participation targets in each of the applicable, authorized NAICS Industry Subsector are provided. Targets are realistic. Specific SDB concerns are identified.
Satisfactory	SDB participation targets in each of the applicable, authorized NAICS Industry Subsector are provided. Targets are realistic. Specific SDB concerns are not identified.
Marginal	No SDB participation targets in the applicable, authorized NAICS Industry Subsector are provided. Satisfactory justification is provided.
Unsatisfactory	No SDB participation targets in the applicable, authorized NAICS Industry Subsector are provided. No justification is provided.

2.6 Volume II, Price Proposal

A price breakdown shall be included in Volume II, "Price Proposal". The Offeror's proposed total price for Bid Item No. 1 shall be broken down according to the following items of work as described on sheet D-l of the contract drawings. Only a lump sum price for each of the items identified below is required. Do not submit a cost breakdown.

A. Work under Phase lA to include: New facility at Fill Stand Area, fill and unloading stands, transfer fuel piping and all temporary work as required. Costs will be broken down by:

1) Mechanical costs under Division 15.
2) Electrical costs under Division 16.
3) All other costs associated with Phase lA.

B. Work under Phase IB to include: Demolition of fuel Area 5, new Diesel Fueling Facility and all temporary work as required. Costs will be broken down by:

1) 30,000 gallon diesel fuel tanks No.1 and 2.
2) All other mechanical costs under Division 15.
3) Electrical costs under Division 16.
4) All other costs associated with Phase lB.

C. Work under Phase 2A to include: Demolition of fuel Area 11, new Operations Area including tanks, and all facilities in the Fuel Operations Area. Costs will be broken down by:

1) Operating tanks No. 3 and 4.
2) Mechanical costs under Division 15.
3) Electrical costs under Division 16.
4) All other costs associated with Phase 2A.

D. Work under Phases 2B thru 2I to include: Installing new Fuel Distribution System including excavation, shoring, dewatering, fuel piping, pits, backfill, testing and all items necessary to complete the system. Costs will be broken down by:

1) Dewatering and care of water.
2) All other costs associated with Phase 2B thru 2I.

E. Work under Phase 3A thru 3C to include: Demolition and abandonment of existing fuel system and restoration work.

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SECTION 00900

MISCELLANEOUS ATTACHMENTS

RESPONSES TO QUESTIONS
SUBMITTED BY PLANHOLDERS
FOR
RFP NO. DACA83-02-R-0004

Q1. Section 00120, Proposal Submission Requirements and Evalution Factors, ¶ 2.1.3 Volume III, Subcontracting Plan (Large Business Concern), page 00120-2, provides that the large business offeror is to submit a subcontracting plan per FAR 52.219-9 in Volume III, and further provides that "Volume III will not be evaluated or rated."

Said § 00120, ¶ 2.5.7.2, Subfactor B -- Past performance in complying with small business subcontracting plan goals, page 00120-9, states:

> If the offeror is a large business concern, the offeror shall submit a small business subcontracting plan in accordance with FAR 52.219-9.

Said § 00120, ¶ 2.2 Proposal Presentation, page 00120-3 states:

> Information pertaining to more than one evalution factor or Subfactor should be repeated in the tab for each factor and subfactor.

Please advise whether the Small Business Plan separately contained in Volume II is also to be included as a separate tabbed item in Factor V, Subfactor B?"

A1. No, a separate Small Business Subcontracting Plan is not required to be submitted in response to Subfactor B.

Q2. Section 00120, ¶ 2.5.7.1, Subfactor A -- Extent of proposed small business subcontracting participation in the performance of the proposed contract, page 00120-9, states:

> Identify in terms of dollar value and percentage of the *total proposed contract price* (emphasis added), the work to be subcontracted to small business concerns, SDB concerns, women-owned small business concerns, HUBZone small business concerns, veteran owned small business concerns . . . .

Paragraph 2.5.7.1.1 Evaluation Standards, page 00120-9 references USACE subcontracting goals as 62% of the *total subcontract value* (emphasis added) to SB, 10% of the total subcontract value (emphasis added) will go to SDB , and 5% of the total subcontract value (emphasis added) will go to WOSB.

Please advise whether the USACE referenced subcontracting goals (emphasis added) are percentages of the prime contract or "total proposed contract price" or are percentages of the totals of all subcontracting - both large and small - the prime contractor will let to others."

A2. Subcontracting goals are the percentages of the total amount to be subcontracted to both large and small subcontractors.

Q3. Please advise whether the USACE has subcontracting goals for HUBZone, veteran owned small business (VOSB), and service disabled veteran owned small business (SDVOSB)."

A3. USACE has a SDVOSB goal of 3%, however, it will not be used as an evaluation standard under this solicitation.

Q4. Paragraph 2.5.7 3 Subfactor C -- Extent of participation of small disadvantaged business (SDB) concerns . . . in the authorized North American Industrial Classification System (NAICS) Industry Subsection, pages 00120-9-10 references targets “in each of the applicable, authorized NAICS Industry subsection, for SDB participation.” At present, offeror is informed and believes that there are at least twenty-six (26) separate NAICS subsections that may provide the type of services and/or type of equipment, materials, etc. that offeror, if awarded the contract, may let. For illustration purposes, these separate NAICS subsection include from such concerns as fuel (454319), waste collection (562111), demolition (235940), and drilling (235810). Assume hypothetically that of these twenty -six (26) separate NAICS subsections, offeror can identify on SBA PRONet at least one (1) SDB per NAICS subsection that is listed as performing eighteen (18) of these separate NAICS subsections. Assume further, but again hypothetically, that these SDB’s are either in Hawaii or perform services nationally.

Please advise if, under the hypothetical circumstances presented, offeror is then to provide specific SDB targets expressed as dollars and percentage of total contract value in each of these separate NAICS subsections identified.

A4. Yes

Q5. If offeror is not to provide specific SDB targets expressed as dollars and percentage of total contract value in each of the separate NAICS subsections for which offeror will subcontract, please advise the correct manner in which offerors are to response to said Subfactor C."

A5. Provide a narrative justification as to why none identified.

Q6. Radiation Safety Officer, 01351-9, para 1.11.3.2)b.
Site Safety and Health Officer is required by the last sentence in this paragraph to comply with the definition of a Radiation Safety Officer on radioactive waste cleanup project per EM 385-1-1. Is this project considered to be a Radioactive Waste Cleanup Project?

A6. This project is not considered to be a Radioactive Waste Cleanup Project. The only radioactive materials anticipated are for the contractor supplied pipe weld testing equipment which will require coordination with the Hickam AFB for bringing it on Base.

Q7. Barricaded, fenced and plated, 01351-17, para 1.25
This paragraph describes Excavation and Trench Safety. The Description Of Work for this specification section states “…while performing cleanup activities on uncontrolled hazardous waste sites.” (01351-2, 1.2). When demolishing the UST and existing hydrant and control pits the work area will be protected, as described, from unnecessary entry, due to the fact the work for this project is located on an active restricted airfield and therefore is a protected area and as such does not require plating or other protection. Please advise if this interpretation is correct.

A7. Your interpretation is incorrect. Plating and/or other protective measures may be required. The active airfield is accessible by authorized AF personnel and measures must be taken to preclude accidents as a result of open excavations/trenches.

Q8. NPDES Permit & Special Environmental Requirements 01354-5,para 1.4.2 and 1.4.3
Please provide the government National Pollutant Discharge Elimination System and air quality under EPA Title V operating permits for storm water drainage that are indicated in the above paragraph to be “included at the end of this section” . Also provide the “special environmental requirements” that were not provided. So that we can review these documents prior to bid.

A8. The Government has completed the NPDES Notice of Intent, Form G, for construction de-watering and has submitted it to the State of Hawaii – Department of Health, Clean Water Branch. We are also in the process of preparing the NPDES Notice of Intent, Form C, but has not as yet completed this action. The EPA Title V permit is available for your review in Am-0002. No other special environmental requirements are known at this time.

Q9. Archaeologist 01354-8, para 3.1.3 and C-1, note 6
Please clarify a conflict between the specifications and drawings regarding the whether the contractor or the Base is responsible to provide the services of a professional archaeologist. The Environmental Protection specification requires that the contractor to retain and pay for the required services that will be approved by the Base. On drawing C-1, note 6 indicates that the contractor to have "close coordination with a qualified archaeologist, hired by the Corps of Engineers…" . We are aware that the specifications take precedence over the drawings, but due to the cost involved we would appreciate a clarification to all of the bidders.

A9. The Government will be providing the Archaeologist to implement the Archeological Monitoring Plan during construction excavation activities. Section 01354, paragraph 3.1.3 will be amended to reflect this clarification.

Q10. Management Action Plan (MAP), 01450-2, para 1.4.1
The Site History paragraph references a MAP for Hickam AFB, dated December 2000 by 15 CES/CEVR. Is this report available for us to review the environmental conditions on the base?

A10. The MAP is available for your review in Am-0002.

Q11. Jack-and-Bore versus Mircotunneling 01900-10 para 1.15.5.t., 02316-5, para 3.1.1.5 and 02441 and C-30 (Line C sta 43+00)C-43 (Line D-1 sta 17+17), C-58 (18" casing)
There appears to be an expensive conflict regarding the methodology required to install casing below the two existing box culverts. The Miscellaneous Provisions and Excavation, Trenching and Backfilling for Utility Systems specification sections refer to the less expensive and most often used method for this application "Jack-and-Bore" or "Horizontal Directional Drilling", while a separate specification section describes a expensive operation for "Trenchless Excavation Using Microtunneling" for two 54 foot lengths of 18" casing at -4 elevation. Please consider correcting the conflict by deleting section 02441.

A11. There is no conflict in the specifications. Paragraphs in Sections 01900 and 02316 generally describe alternatives to open cut installation that are described in detail in Section 02441.

Q12. Pipe Bedding, 02316-3, para 2.1.6 and C-51, detail B
The pipe bedding material callout for the exterior coated stainless steel pipe to be in accordance with "ASTM C33" (concrete aggregate) with a gradation of 100 passing the 3/8" sieve". Our experience with installing thousands of feet of exterior coated pipe and other utilities throughout the US and Hawaii is that the C33 product is extremely expensive as well as design overkill for the intended purpose. We have successfully used a local Hawaiian product by the name of "3B Fine" (ASTM D448) as bedding on previous exterior coated pipe projects. The 3B Fine product complies with the exterior coating manufacturer's pipe bedding requirements. The cost savings on the project could be $150,000 to $200,000 if the 3B Fine product is allowed to be used for the pipe bedding. Please consider changing the pipe bedding requirement.

A12. Use of 3B fine of pipe bedding is acceptable provided that you provide a certification that the aggregate meets the exterior coating pipe manufacturer's pipe bedding requirements.

Q13. Hydrant Fuel Pit, 15050-14, para 2.12.1 & 2.12.2 and S-31 & C-51
There appears to be a conflict between the specification (2.12.12, line 27) requiring the pit surface elevation to be installed 2" below the top of adjacent concrete and the details on contract drawings S-31 and C-51, which show the pit surface to be installed even with the surrounding concrete that is sloped up to a 2" crown in a 3' perimeter of the pit lid. The drawings indicate our recommended installation elevation. Please clarify.
Also, based on conversations with numerous contractors NO hydrant pits are truly "waterproof". We respectfully request that the wording be changed to "water resistant", which is obtainable with a gasketed pit cover.

A13. Section 15050 will be modified to clarify position of lid with respect to surrounding pavement.

Q14. Level Gauges for PRT & DTs, 15050-11, para 2.11 & 13204-9, para 2.5 and M-37, M-38 & E-29
There is no specification for the level gauges for the Product Recovery Tank and the Diesel Tanks. The drawings show "Liquid Level Indicator and Temperature Transmitters". This is similar to the requirement for the Operating Tanks specified in section 13205-15, para 2.10.4 "Servo Tank Level Gauging System". Unless advised otherwise we will consider that this is the same type required for the PRT and Diesel Tanks. We recommend that you provide this same information to the other bidders.

A14. Your interpretation is correct. Use Servo System per Section 13205, paragraph 2.10.4.

Q15. Double Block and Bleed Valves, 15060-14 , para 2.3.2
There are places on the drawings where the DBBV are noted as "ss". See detail 1/M34, valves on M-13, M-14, detail 2/M21, M-22, 1/M25 and so on. The specification states "stainless steel or carbon steel body". Stainless steel body DB&B valves are extremely expensive. We have installed over 25 fuel systems for the Federal Government throughout the past 25 years, several of which were Type III Hydrant Fuel systems like this project. All of this projects included DBBV, but none have required stainless steel bodies. Given the price difference of more than 5 times the cost between chrome-plated carbon steel and stainless steel, plus a number of 50+ DBBV on this job it appears to be an exorbitant cost for the project. Please consider changing all of the "ss" callouts on DBBV to "cs".

A15. Provide "ss" as specified and shown in the contract documents.

Q16. Pig Launcher 15060-14, para 2.9 and M-25
Please advise if the Pig Launchers are intended to be installed for this project. The contract drawings indicate the pig launchers will be installed in the "future". The Fuel Equipment specification section lists the requirements for pig launchers and receivers. Unless we are advised otherwise the pig launcher and receiver will be considered as future installed items.

A16. The launchers/receivers provided under this project are only for the cleaning pigs. The long barrels for smart pigging are shown in dashed lines to indicate "future".

Q17. Size of Vent and Drain pipe
Detail C/M-40 shows the low point drain and high point vent piping. There is a statement that the vents and drains on 10" pipe and larger are to be 2" size. Drawing M-5 shows the P&ID of the Receipt line to the storage tank. There are (2) manual air vents down stream of the filter separator discharge header. The header is 10" and yet the vents are shown as 1". One of the vents is shown on drawing M-20 and shows an automatic air vent. The same vent is shown on detail 6/M-21, as a manual 1" vent. There are also automatic air vents shown on the pump and filter separator headers. The only dimension given is on the manual valve which is shown as 2". The specifications, section 15060 para. 2.12, state that the automatic air vents are 1". We will use 1" vents where shown and 2" on 10" pipe and larger unless otherwise noted.

A17. Use 1" on air vents and 2" on low point drains for larger pipes.

Q18. Soil Report 02300 Earthwork and C-59
Was a soil report prepared for this project? If so, can one be made available for our review prior to bid?

A18. A geo-technical report was completed and can be made available for your review at our office. Please call Ms. Jody Muraoka at (808) 438-8575 to review the geo-technical report.

Q19. Construction sub-phasing project schedule D-2
We understand from the site visit yesterday that a reasonable construction schedule will be agreed between the contractor and the Base personnel in lieu of the detailed sub-phasing tables on the demolition layout drawings. We are in full agreement with this decision.

A19. During the pre-proposal conference, it was noted the alternate phasing may be considered but it will have to be beneficial to the Government and also minimize impacts to the airfield operations. However, you should prepare your bid in accordance with the specified phasing schedule depicted on the contract documents.

Q20. Please specify what area of the project is Section 02761, Fuel-Resistant(Coal Tar) Sealer applicable.

A20. Fuel-Resistant Sealer is to be used on all new AC pavement as indicated on Details A and B of sheet C-54.

Q21. Section 09900, Painting-General, paragraph 3.10, painting schedules, specify that aluminum, aluminum alloy, and other non-ferrous metal are to be painted. Are exterior stainless steel pipings and fittings and other stainless steel items which are consider as non-ferrous to be finish painted.

A21. Exterior stainless steel items should not be painted.

Q22. Sheet No. M-13 has a match-line that refers to Sheet No. M-14. When these drawings are "matched" Operating Tank No. 3 appears to breach the intermediate dike wall. It appears that the dimensions are incorrect on these drawings. Please provide clarification.

A22. The match line depicted on Sheets M-13 and M-14 is incorrect and does not properly depict the correct relationship of Operation Tank #3 to the dike. The 16" and 10" SS pipes should have extended out further. The layout of the Operating Tanks are as depicted on Sheet M-3.

Q23. Which bid item is the Analytical testing is to be measured for payment.

A23. It is part of the base bid.

Q24. Is data available for the TCE that has been detected at the lower ramp?

A24. Please see Section 00900, Appendix C, Spill Site Management Plan, which is attached to this amendment (Am-0006).

Q25. Does the TCLP requirement include pesticides and herbicides?

A25. Yes, if it says full TCLP then TCLP-Pest and TCLP-herb are also included.

Q26. RE: TYPICAL AIRCRAFT-RATED HANDHOLE. Drawing E-24, detail B, notes 1 & 2 requires a design to support the indicated loads. Walls shall be designed for vertical & lateral pressures and shall be capable of supporting a minimum of 100,000 lb. ultimate load.
We require the wheel print size for the 100 kip loading for the design requirement.

A26. The 100,000 lb loading is the minimum required for the handhole lid itself. In accordance with the FAA circulation AC 150/5320-6D, the 100,000 lb load shall be distributed based on a tire pressure of 250 psi (i.e. resulting in a 400 sq. in. area). For the concrete handhole structure, the reference called out for a loading criteria of 75,000 lb per wheel in an approximate 5' wheel spacing in each direction (2 x 4 wheel pattern = 8 wheels total).

Q27. Section 00010 Proposal Schedule, Item No. 9 is for "Chemical analysis of soil and groundwater samples (full TCLP)". However, Section 01450 paragraph 1.4.3.1 entitled Soil and Ground Water Samples, requires chemical analysis of BTEX, Lead Cadmium, TPH, and TCLP. Should Item No. 9 be limited to full TCLP or should the additional tests be included in this item no.?

A27. Limit tests to full TCLP.

Q28. The tank removal spec (Section 02115, paragraph 3.9.3 and 3.10) says that contaminated soil above Action Levels CANNOT be used as backfill in the tank excavation. The spec (paragraph 3.9.3) says that soil that exceeds Action Levels shall be managed in accordance with Section 02111. But Section 02111 paragraphs 1.5 and 3.3 say contaminated soil shall be used for backfilling in the same area in which it was excavated. is it your intention that backfilling with contaminated soil is okay in the trenches but not in the tank excavations. ???

A28. It is the intention that backfilling with contaminated soil is OK in the trenches but not in the tank excavations, because UST removal falls under different regulations.

DRAFT

SPILL SITE MANAGEMENT PLAN

SUBSURFACE PLUME MONITORING AND LONG TERM MAINTENANCE AND
LONG TERM OPERATIONS OF MONITORING AND RECOVERY WELLS
Hickam Air Force Base, Hawaii

Contract No.: DACA 83-95-D-0003
Delivery Order No 0030

BES Job # 4918.03
February 27, 1998

Prepared For:

United States Army Corps Of Engineers
Pacific Ocean Division

and

United States Air Force
15th Air Base Wing CES/CEVR

Prepared By:

Brewer Environmental Services
of
Brewer Environmental Industries, LLC

LIST OF ABBREVIATIONS

°F	degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
AFB	Air Force Base
ALs	Action levels
API	American Petroleum Institute
ARARs	Applicable, Relevant and Appropriate Regulations
BES	Brewer Environmental Services
BTEX	benzene, toluene, ethylbenzene, total xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES/CEVR	Civil Engineering Squadron / Environmental Restoration
cm/s	centimeters per second
dh/dl	groundwater gradient (change in height/change in length)
DNAPL	Dense Non-Aqueous Phase Liquid
DOD	Department of Defense
DOH	State of Hawaii, Department of Health
EA	EA Engineering, Science, and Technology, Inc
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
fbg	feet below grade
ft	feet
ft/dy	feet per day
ft/yr	feet per year
HCP	Hydrant Control Pit
HEER	Hazard Evaluation and Emergency Response
Hg	Mercury
HVOs	Halogenated Volatile Organics
IRP	Installation Restoration Program
k	hydraulic conductivity
Koc	partitioning coefficient between organic carbon and water
Kow	partitioning coefficient between octanol and water
LEL	Lower Explosive Limit
LFM	Liquid Fuels Maintenance
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Limit
mg/m^3	milligrams per cubic meter

MPE	Multiphase Extraction
MSgt	Master Sergeant
msl	mean sea level
n_e	effective porosity
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PAHs	polynuclear aromatic hydrocarbons
Pb	Lead
PEL	Permissible Exposure Limit
POL	Petroleum, Oil and Lubricants
ppm	parts per million
ppmv	parts per million by volume
PREE/CA	Presumptive Remedy Engineering Evaluation/Cost Analysis
RBCA	Risk-Based Corrective Action
REL	Recommended Exposure Limit
STEL	Short Term Exposure Limit
SVE	Soil Vapor Extraction
SVOCs	Semi-Volatile Organic Compounds
TCE	Trichloroethylene
TEL	tetraethyl lead
TLV	Threshold Limit Value
TML	tetramethyl lead
TOC	top of casing
TPH	total petroleum hydrocarbon
TPH-JP-4	total petroleum hydrocarbon as jet fuel 4
TPH-JP-8	total petroleum hydrocarbon as jet fuel 8
TSgt	Technical Sergeant
TWA	Time Weighted Average
USAF	United States Air Force
v	velocity
VOCs	volatile organic compounds

1.0 SPILL SITE DESCRIPTION

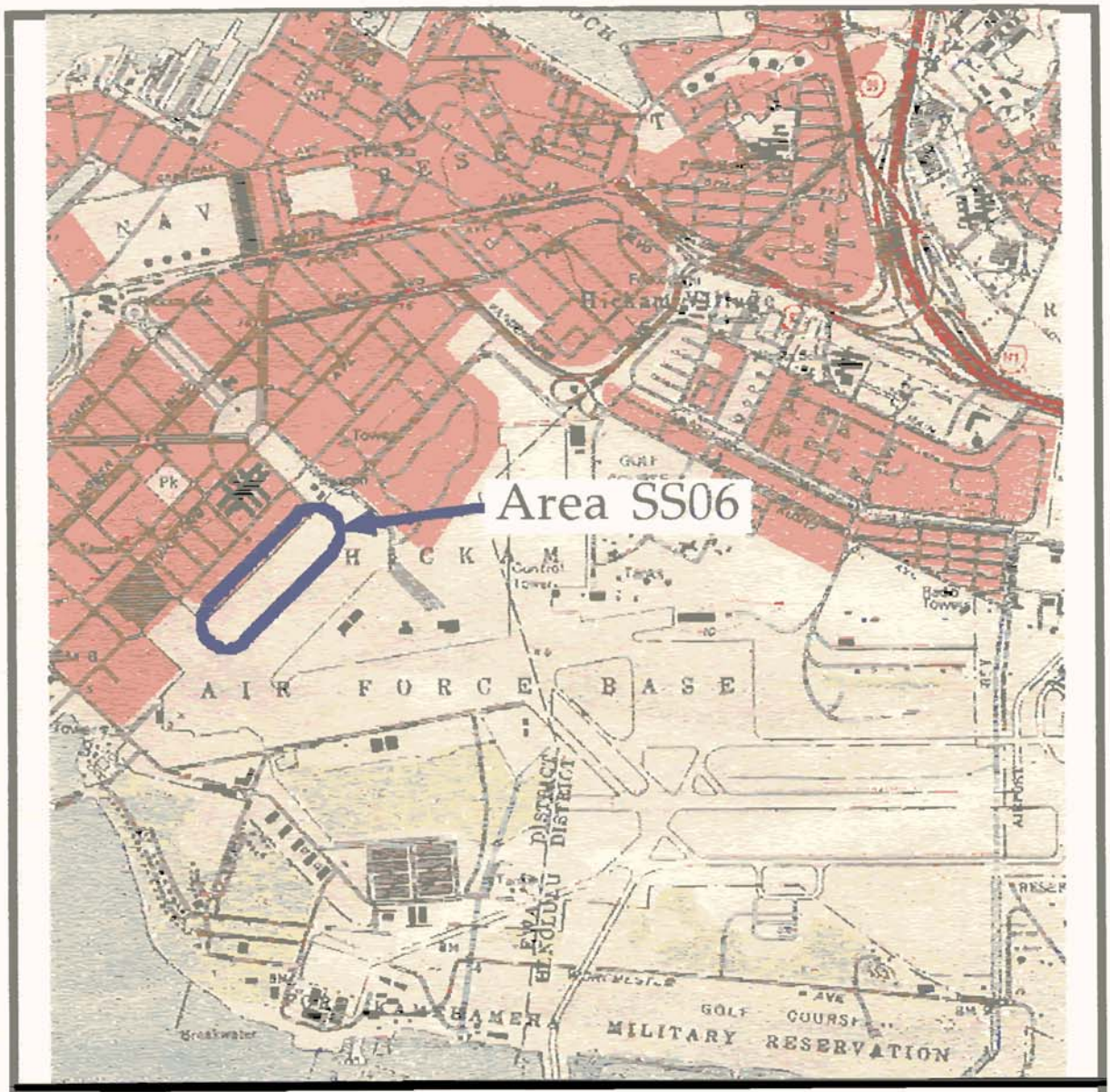
Site SS06, previously identified as Areas B (Hirata, 1983) and Site 9 (Hirota, 1983), is an Installation Restoration Program (IRP) fuel leak site that is located proximal to the flight line along the active fuel distribution pipeline east of Hangars 2030, 2035, 2040, and 2045, also known as Hangar Row (Figure 1). Four valve pits situated along the fuel distribution line have also been combined with this site. The site contains a JP-8 fuel distribution system consisting of hydrant control pit 1 (HCP1) in the vicinity of Building 2045, through HCP4 in the vicinity of Building 2030, seven hydrants (P1A, P1B, P1C, P2A, P2B, P3A, P4A) and approximately 1600 feet (ft) of buried connecting trunk line (Figure 2).

At the present, a 6 inch pipeline brings in fuel from tanks in Fuels Area 11, located to the east across the airfield, just south of the Par 3 Golf Course. The main line ties into the 1600 ft trunk line just south of HCP1. The trunk line then distributes the fuel into the four HCPs, which in turn distribute the fuel to the connected hydrants. HCP1 distributes to hydrants P1A, P1B, P1C. HCP2 distributes to hydrants P2A and P2B. HCP3 and HCP4 distribute to P3A and P4A, respectively. Previously the trunk line was fed by an 8 inch pipeline running from the cargo pier up Hangar Avenue. This line has been taken out of service.

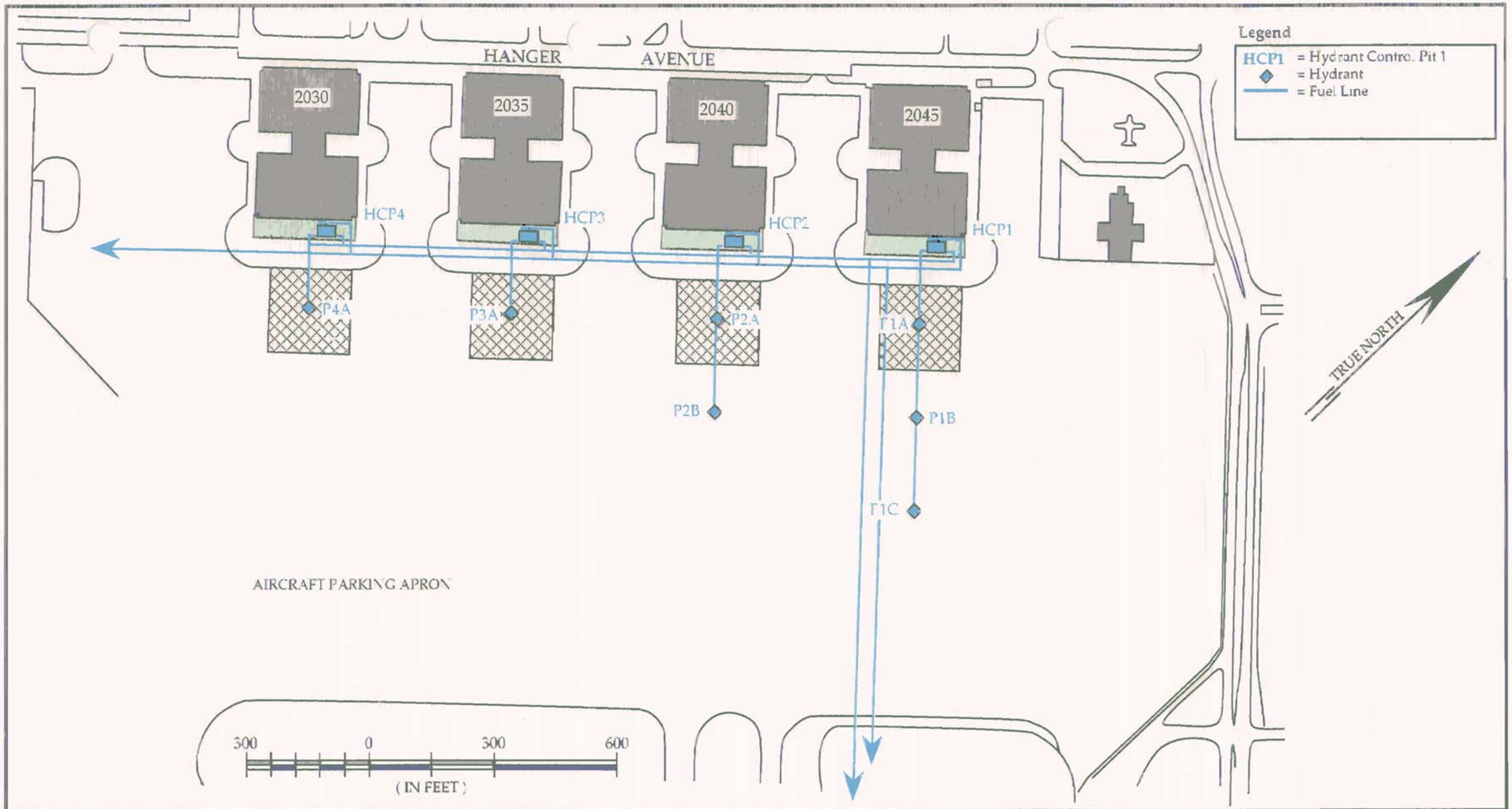
The fuel lines, HCPs, and hydrants are all buried underground. Each HCP is covered by a 21 inch thick, 100 ft by 100 ft, square concrete pad. Surrounding the hydrants is the aircraft parking apron whose surface is paved by asphalt.

A 1996 site investigation showed the presence of a product plume underneath Hydrant 1 extending to Hydrant 2 (Brewer Environmental Services [BES], 1997). The product plume shows elevated total petroleum hydrocarbon (TPH) concentrations in different areas, suggesting that the plume originated from separate leaks. Two areas with highest TPH concentrations are located on Hydrant 1: between fueling pits P1A and P1B and at fueling pit P1C. These two areas have product on top of the water table (MW2 and MW3). Other areas are located on Hydrant 2, at the fueling pits P2A and P2B. The product plume has not been delineated to the south, southeast, and northeast.

In addition, two smaller product plumes exist: one at the fueling pit P4A at Hydrant 4 and one close to the low point drain between Buildings 2035 and 2040. The low point drain is part of the fuel lines running along the service road which borders the aircraft parking apron to the northwest. The plume beneath the service



Brewer Environmental Services	Location Map	Job No. 4918
	Hickam Air Force Base	Figure: 1
	Oahu, Hawaii	Page: 3-8



Brewer Environmental Services	Site Map	Job No: 4918
	Spill Site Area SS06	Figure: 2
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-9

road is confined to the vadose zone, while the groundwater did not contain measurable TPH concentrations.

The data suggest that the fuel leaks originate mostly from the fueling pits (P1C, P2A, P2B, P4A) possibly due to leaking joints. One leak appears to originate from a low point drain underneath the service road. The most prolific leak seems to originate from the fuel line between the fueling pits P1A and P1B. However, it cannot be excluded that the leak originates from P1A and follows a preferential flow path along the backfill surrounding the fuel line, rather than spreading circular.

2.0 HISTORICAL REVIEW

Contamination for this area is probably the result of leakage from the pipeline supplying fueling hydrants P5A through P8A, and spillage during fueling operations (Hirota, 1983).

According to an EA Engineering, Science, and Technology, Inc. (EA) report, the hydrant distribution system was completed in 1942 (EA, 1997). At that time, the system was supplied with JP-4 from a fuel storage area (Fuel Area No. 2) located between the Hickam Air Force Base (AFB) control tower and Hangar Avenue. Fuel Area No. 2 was in turn supplied from Fuel Area No. 1, further south along Hangar Avenue, which was fed directly from the cargo pier at the southward extension of Vickers Avenue.

Around 1979 or later, the fuel supply system was altered. Fuel was then supplied from Fuel Area No. 9 built across the airfield to the east. Fuel Area No. 9 is marked as a new fuel storage area on a map dated 1979.

According to personal communication with Master Sergeant (MSgt) Thomas Carter of Liquid Fuels Maintenance (LFM) and Mike Youn of the Hickam AFB fuel farm, JP-4 was phased out in June through July 1992 and replaced with JP-8. According to personal communication with Technical Sergeant (TSgt) Brown of LFM, there were at least seven leaks in SS06 between 1990 and 1994.

Several plans located during the records search validate leakage from the pipeline supplying fueling hydrants, area valve pits, and hydrants (i.e., United States Air Force (USAF), 1968, 1973, 1974c, 1975, 1979, 1980, 1992). The aforementioned plans address the replacement or repair of Petroleum, Oil, And Lubricants (POL)

lines, valve pits, and hydrants and it is suspected that the repairs performed on specific components of the POL system were not maintenance related.

During a 1983 subsurface investigation of Hickam AFB, fuel odor and surface film were observed in boring hole number B1 (Hirata, 1983). Boring number B1 was locate proximal to the fuel hydrant adjacent to Hangar 2045. Neither fuel odor nor surface film were observed in the remaining boring holes numbered B2 through B5 (Hirata, 1983).

In the early 1990's, contaminated soil was discovered during an upgrade construction project between HCP1 and Hydrant P1B. No documentation regarding the extent and type of the contamination was available. In 1994, the fuel lines near HCP3 failed a tightness test. The system also failed a retest, although there is no visual evidence of a release or documentation supporting any fuel loss. Concern has also been expressed over possible leakage from the trunk line between HCP1 and HCP4.

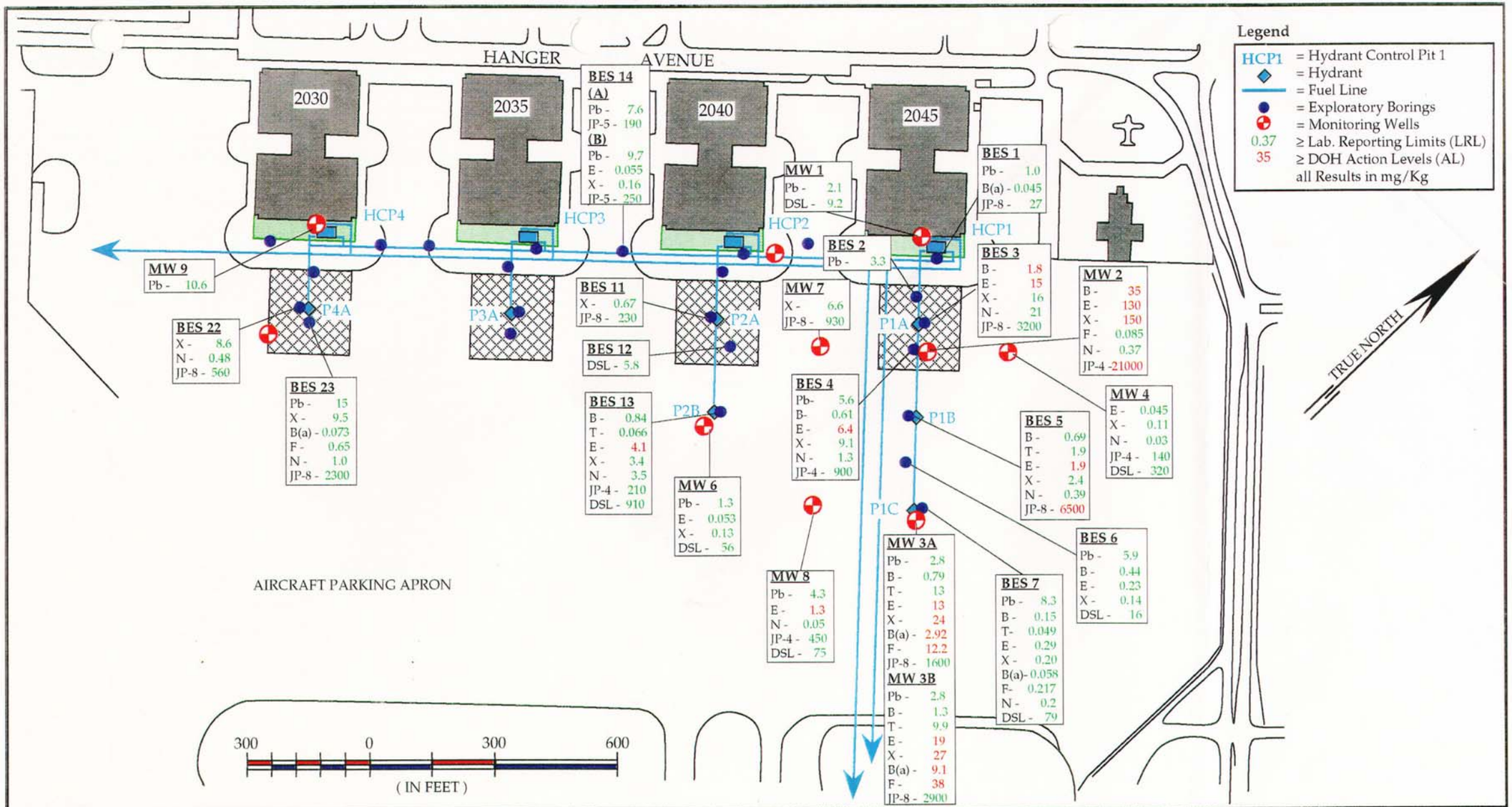
During a 1996 site investigation, conducted by BES, elevated organic vapor concentrations were measured in the soil along hydrant lines connected to HCP1, HCP2, and HCP4. The levels were 45 to >2,500 parts per million by volume (ppmv), 0 to >2,500 ppmv, and 20 to 1,935 ppmv, respectively. However, only two out of 10 monitoring wells contained product. Increase in the product thickness was observed between September and October 1996.

3.0 CONCEPTUAL SITE MODEL

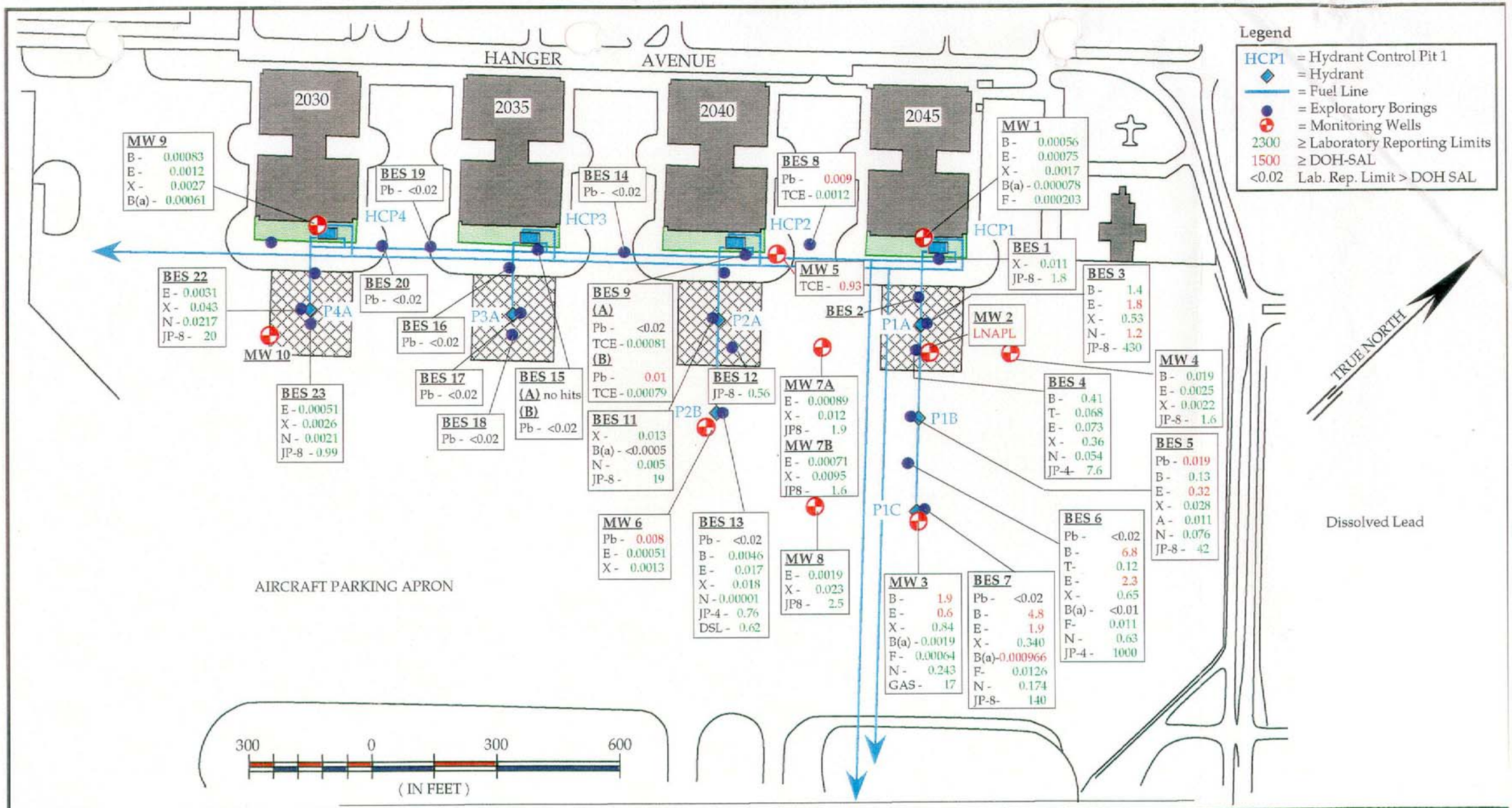
3.1 CHEMICALS OF POTENTIAL CONCERN

3.1.1 Contaminant Distribution

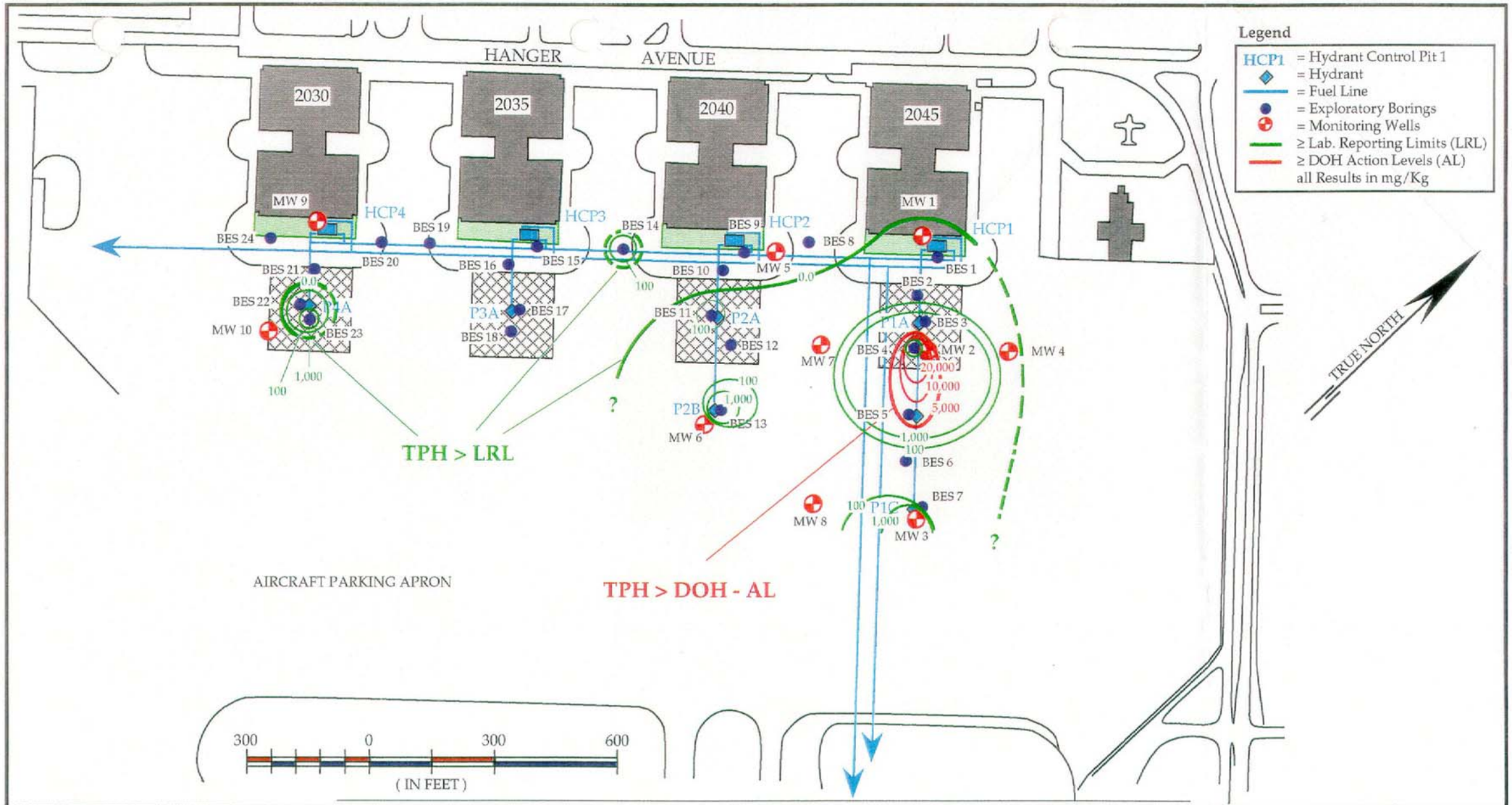
The latest soil and groundwater chemical analytical results is summarized in Figures 3 and 4 and Appendix A (BES, 1997). Fuel constituents in excess of the State of Hawaii, Department of Health (DOH) Tier 1 action levels (ALs) were found in connection with the plume extending across Hydrants 1 and 2. These constituents were total petroleum hydrocarbon as jet fuel (TPH-JP-4 and TPH-JP-8) in soil (Figures 5 and 6); the volatile organic compounds (VOCs) benzene, toluene, ethylbenzene, and total xylenes (BTEX) in soil and groundwater (Figures 7 and 8); and the polynuclear aromatic hydrocarbons (PAHs) acenaphthene, benzo(a)pyrene,



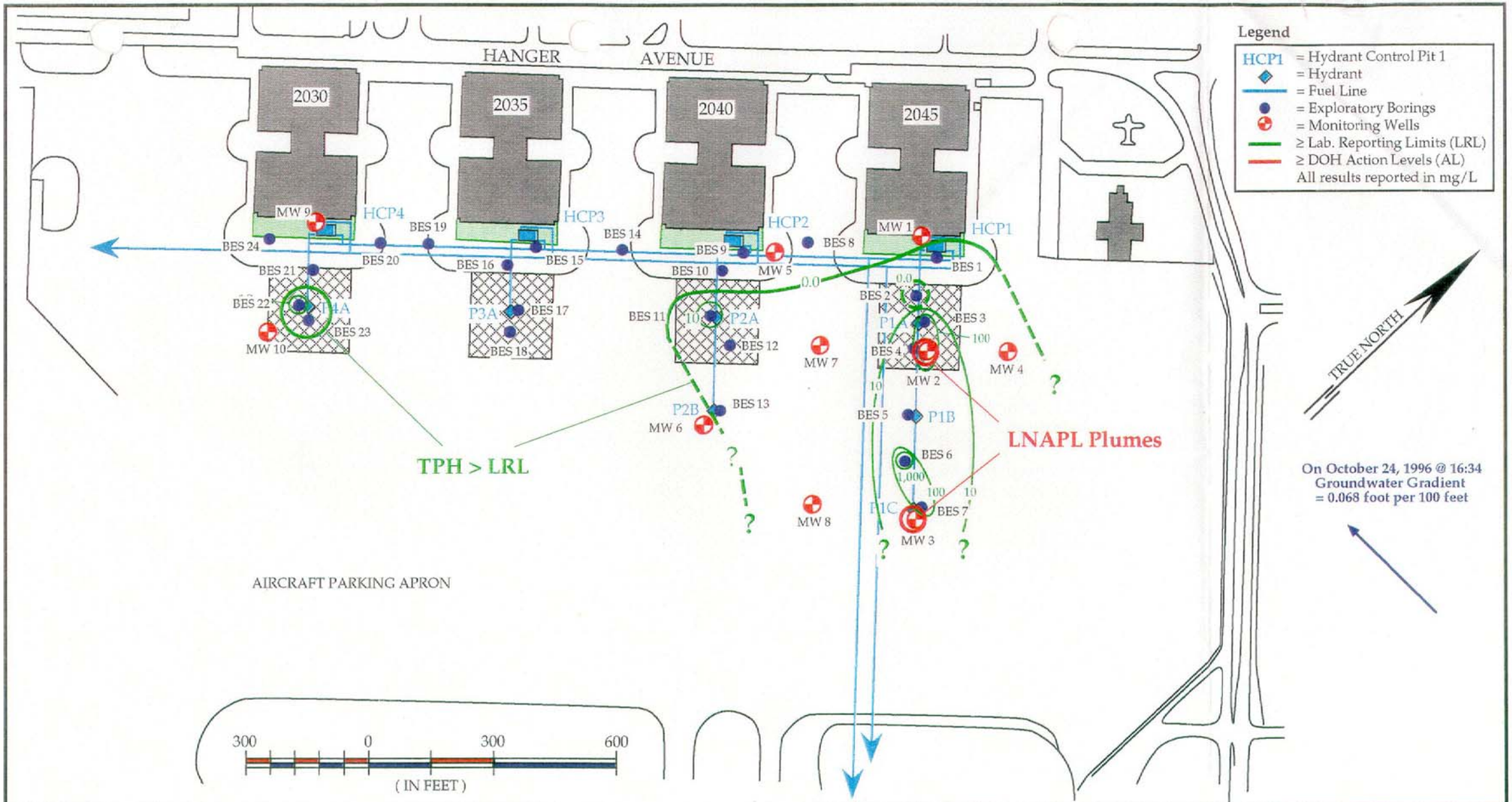
Brewer Environmental Services	Soil Chemical Analytical Results	Job No: 4918
	Spill Site Area SS06	Figure: 3
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-12



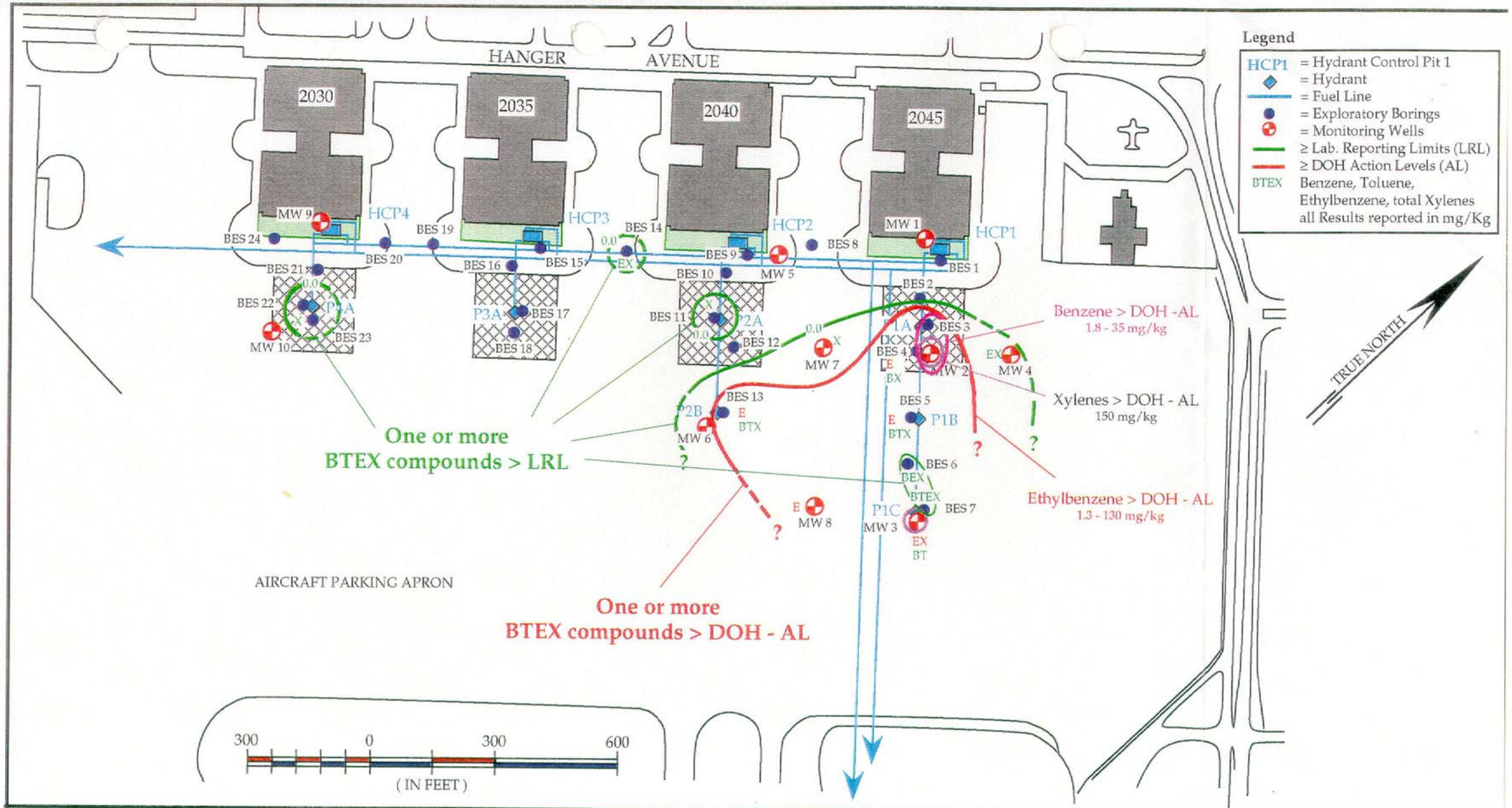
Brewer Environmental Services	Ground Water Chemical Analytical Results	Job No: 4918
	Spill Site Area SS06	Figure: 4
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-13



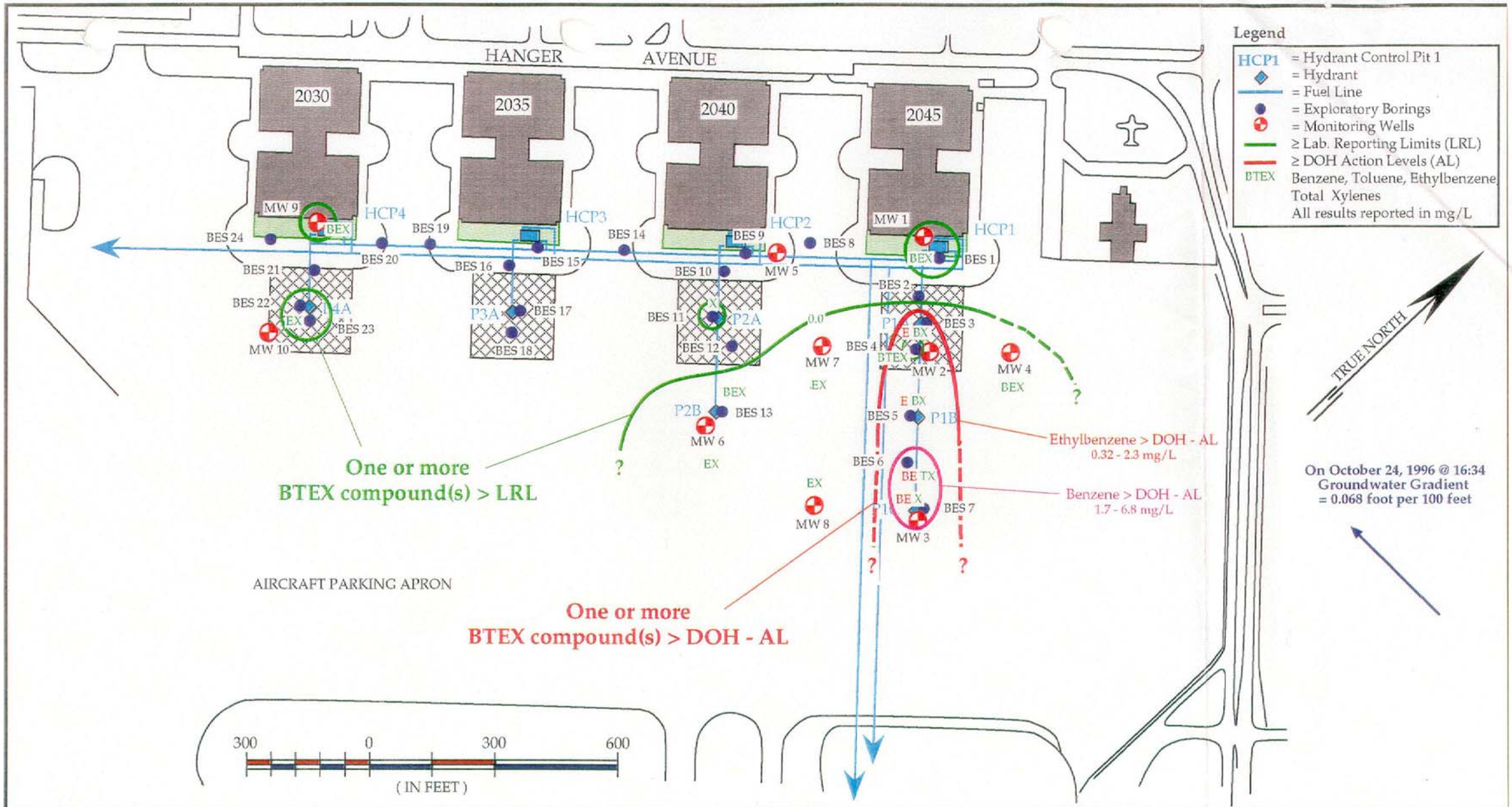
Brewer Environmental Services	Total Petroleum Hydrocarbons in Soil	Job No: 4918
	Spill Site Area SS06	Figure: 5
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-14



Brewer Environmental Services	LNAPL Plume & Total Petroleum Hydrocarbons Dissolved in Groundwater	Job No: 4918
	Spill Site Area SS06	Figure: 6
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-15



Brewer Environmental Services	Benzene, Toluene, Ethylbenzene, & Total Xylenes in Soil	Job No: 4918
	Spill Site Area SS06	Figure: 7
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-16



Brewer Environmental Services	Benzene, Toluene, Ethylbenzene, & Total Xylenes in Groundwater	Job No: 4918
	Spill Site Area SS06	Figure: 8
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-17

fluoranthene, and naphthalene in soil and groundwater (Figures 9 and 10). BTEX and PAHs are compounds found in jet fuel.

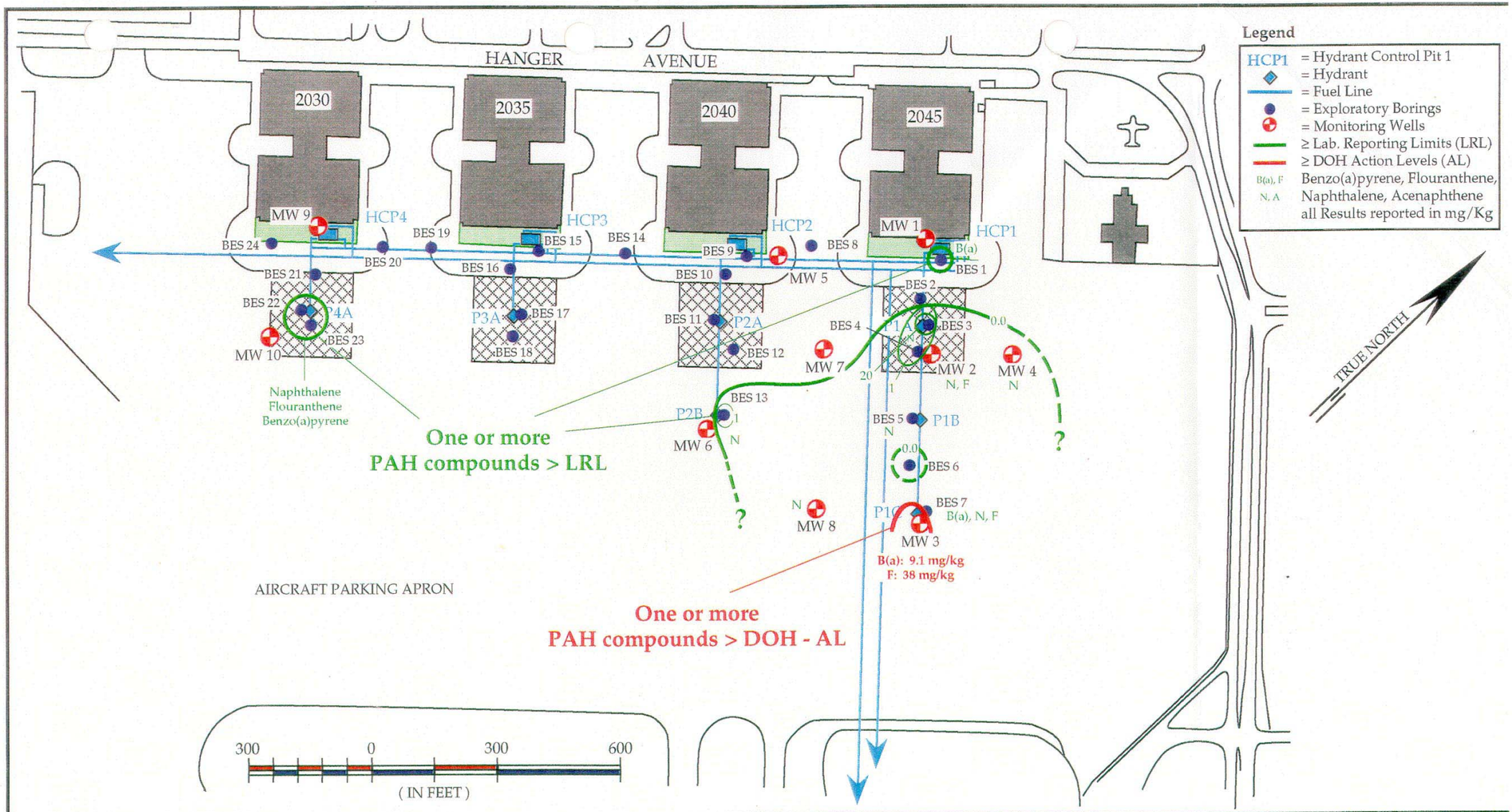
In addition, two separate phase product plumes were found floating on top of the water table at Hydrant 1. The BTEX (soil and groundwater) and PAHs (in soil) contamination in excess of the DOH-ALs has not been delineated towards the east and southeast.

Dissolved lead was found in excess of the DOH-AL at various locations across the site. Its occurrence does not correlate with the fuel plume, suggesting that the lead and fuel contamination are unrelated (Figure 11).

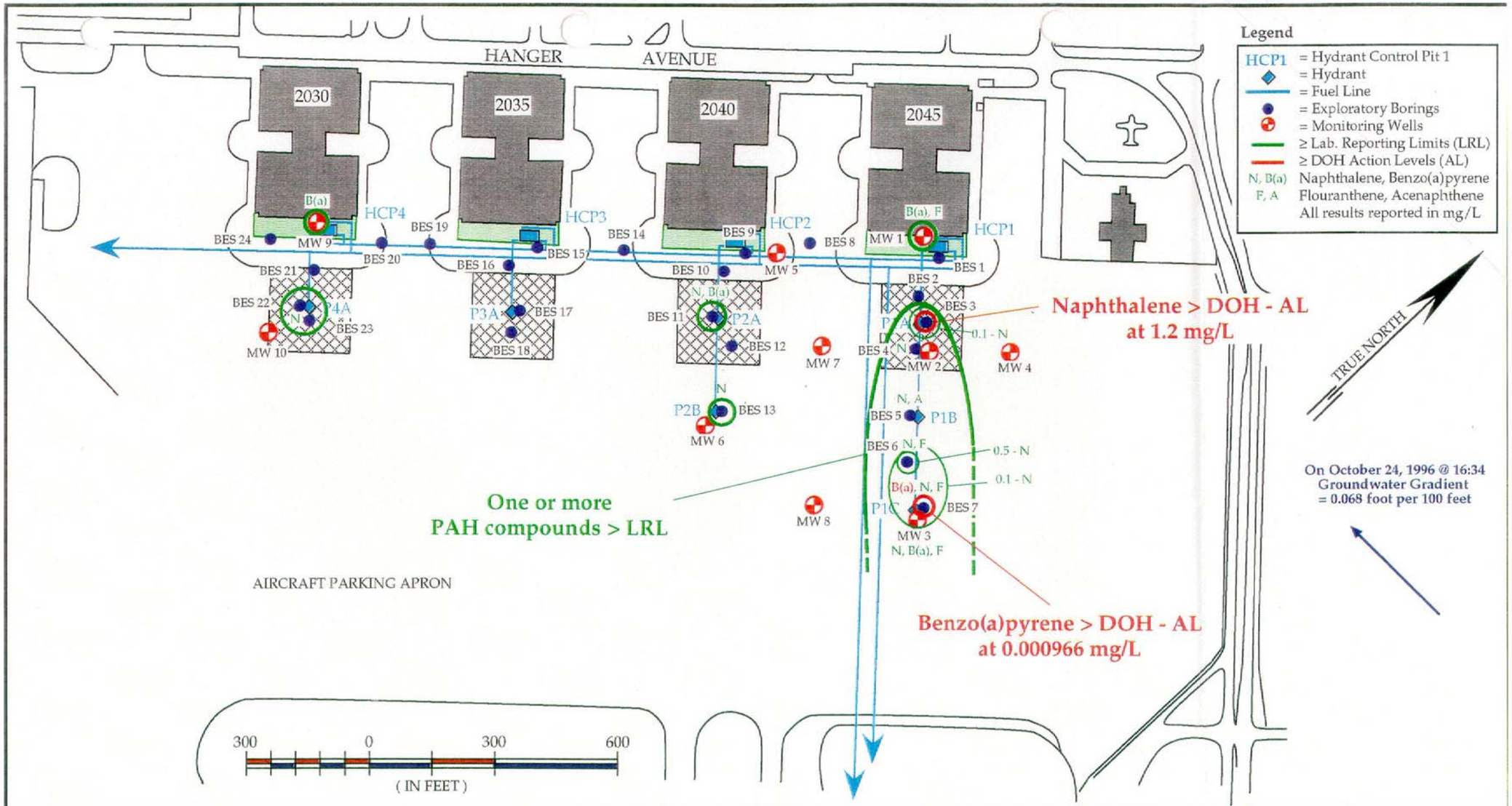
Dissolved Trichloroethylene (TCE) was found in excess of the DOH-AL in a boring (MW5) on the service road between Building 2040 and 2050. The dissolved TCE plume extends to include two other borings BES8 and BES9 (Figure 12). However, the plume was not delineate in the north and west directions. The TCE contamination was not found in the vadose zone, indicating that the borings did not penetrate the source area. Since TCE is heavier than water it is not expected to accumulate and spread in the capillary fringe, but rather at the bottom of the aquifer if released in sufficient quantity. Low concentrations of TCE will be retained in the soil due to capillary action and adhesion to soil particles. Low concentrations of TCE in the soil will be best traced by active soil vapor extraction and analysis. The source of the TCE contamination has not been determined, and the potential existence of a separate phase TCE plume has not been investigated.

The plume across Hydrant 1 and Hydrant 2 contains mostly JP-8 with a minor amount of JP-4. The plume on Hydrant 4 contains JP-8. The plume on the service road contains JP-5, although the chromatogram could also be interpreted as JP-8. Longer chain hydrocarbons were detected at low levels and could not be identified

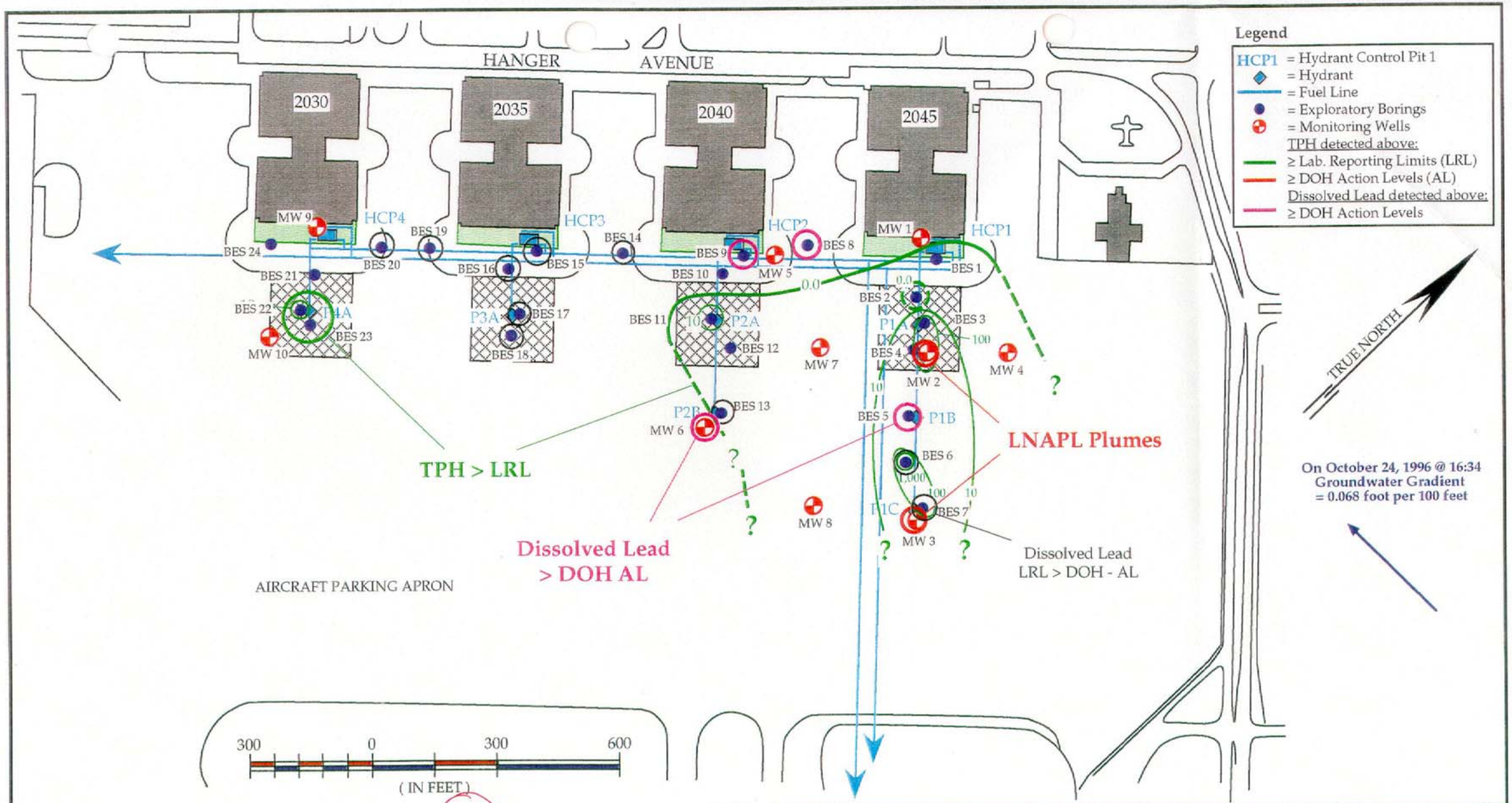
The fuel identification matches the use of the Hydrants. The Hydrants are currently used to dispense JP-8, which is delivered from a tank farm located south of the Par 3 Golf course via a six inch pipeline. Prior to this, the hydrants dispensed JP-4, which was delivered from a cargo pier to the southeast via an eight inch pipeline.



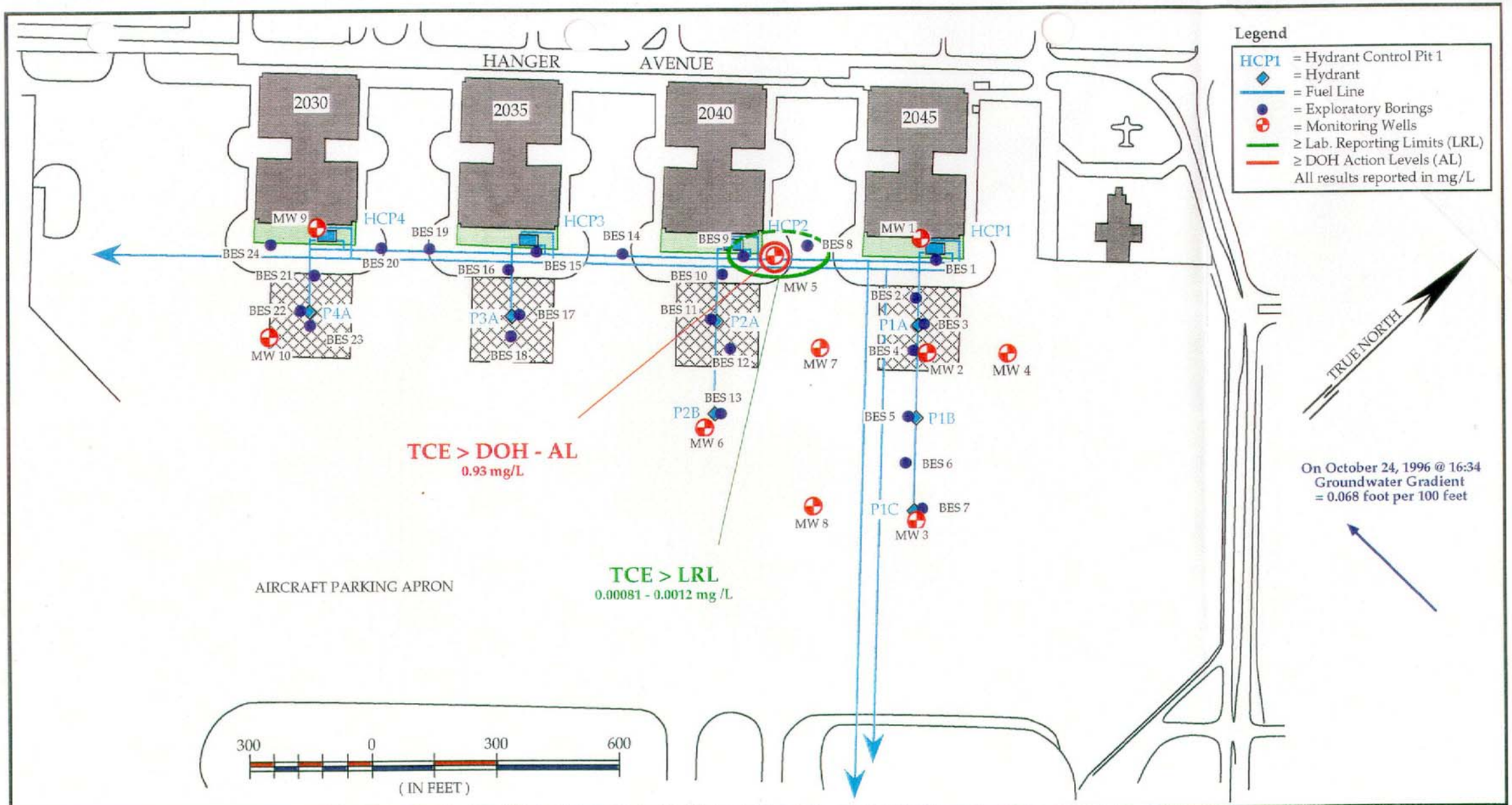
Brewer Environmental Services	Polynuclear Aromatic Hydrocarbons in Soil	Job No: 4918
	Spill Site Area SS06	Figure: 9
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-19



Brewer Environmental Services	Polynuclear Aromatic Hydrocarbons (PAHs) in Groundwater	Job No: 4918
	Spill Site Area SS06	Figure: 10
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-20



Brewer Environmental Services	LNATotal Petroleum Hydrocarbons & Dissolved Lead in Groundwaterwater	Job No: 4918
	Spill Site Area SS06	Figure: 11
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-21



Brewer Environmental Services	Trichloroethene (TCE) in Groundwater	Job No: 4918
	Spill Site Area SS06	Figure: 12
	Hickam Air Force Base, Honolulu, Hawaii	Page: 3-22

3.1.2 Contaminant Characteristics

3.1.2.1 JP-8

JP-8 is principally composed of kerosene, that is a mixture of hydrocarbons with carbon chains ranging from C-9 through C-16. The hydrocarbon compounds include 30% monocycloparafins, 25% normal parafins, 16% mononuclear aromatics, 11% branched parafins, and 5% dinuclear aromatics. In addition JP-8 contains less than 0.5% additives. Amongst the hydrocarbon compounds are BTEX and PAHs. JP-8 is not very volatile and its vapors are heavier than air, which causes them to accumulate in low places. The density of JP-8 is less than that of water, which makes it a light non-aqueous phase liquid (LNAPL). It is classified as a class II combustible liquid with a flashpoint of 100 degrees Fahrenheit (°F) and a boiling point of 320 °F. The lower explosive limit (LEL) is 0.7%.

The product is a mild irritant with the highest hazard being related to inhalation of airborne mist. Acute inhalation exposure may cause mild eye irritation, dry skin, headache, confusion, drowsiness, chest heaviness, weakness, restlessness, incoordination, nausea, vomiting, and diarrhea. Aspiration may cause chemical pneumonitis, and prolonged or repeated exposure may result in kidney or liver damage. Although JP-8 is not considered a carcinogen, American Petroleum Institute (API) studies indicate that repeated overexposure may cause cancer in mice.

Neither the Occupational Safety and Health Administration (OSHA) nor the American Conference of Governmental Industrial Hygienists (ACGIH) have established a minimum permissible exposure limit (PEL) or threshold limit value (TLV), however, the National Institute for Occupational Safety and Health (NIOSH) has a recommended exposure limit (REL) of 700 parts per million (ppm).

3.1.2.2 JP-4

Like JP-8, JP-4 is a fuel for jet, i.e. Turbine, engines. However, JP-4 is lighter than JP-8 with hydrocarbon compounds ranging from C-4 through C-16. 65% of its hydrocarbon compounds are in the gasoline range and 35% are light petroleum distillate. In specific JP-4 contains alkanes, cycloalkanes, alkylbenzenes, indan/ tetralines, and small amounts of benzene (0.5%) and hexane (2.2%). Amongst the hydrocarbon compounds are BTEX and PAHs. Other additives, which are found in all jet fuels, include antioxidants, metal deactivators, fuel system icing inhibitors, corrosion inhibitors, and static dissipater additives. JP-4 has a flashpoint of -10 °F, and an autoignition temperature of 468° F. It is classified as a class IB flammable

liquid, and its LEL is 1.3 %. JP-4 vapors are heavier than air. The density of JP-4 is less than that of water, which makes it a LNAPL.

Acute exposure symptoms include skin and eye irritation. Overexposure by inhalation can result in headache, dizziness, nausea, depressed activity, anxiety, memory loss, irritability, poor coordination, and convulsions. Chronic exposure symptoms are negative central nervous system and blood effects, and liver damage. There are no other exposure limits for JP-4, but an Industry REL, which is 200 ppm and an industry short term exposure limit (STEL) of 300 ppm.

3.1.2.3 Dissolved Lead

Dissolved lead at the site does not correlate with the jet fuel plume, which was to be expected since lead is not usually an additive of JP-8 or JP-4. The source of dissolved lead can therefore not be discerned and it is unknown whether the lead occurs as a cation or an organic lead compound.

Exposure routes for inorganic lead include inhalation, ingestion and dermal contact, with the target organs being the gastrointestinal tract, the central nervous system, kidneys, blood, and gingival tissue. Overexposure to inorganic lead can cause weakness, lassitude,insomnia, facial pallor, anorexia, constipation, abdominal pain, colic, anemia, tremor, paralysis of ankles and wrists, encephalopathy, nephropathy, irritation of the eyes, and hypotension. The time weighted average (TWA) exposure limit set by OSHA is 0.50 milligram per cubic meter (mg/m^3) of air, the TWA exposure limit is 0.100 mg/m^3.

Organic lead compounds in fuel are most commonly tetraethyl lead (TEL) or tetramethyl lead (TML). Organic lead additives have toxic properties, which require stringent precautions against dermal absorption and inhalation. However, skin absorption is greatly reduced, when the lead compound is diluted to below 10%. But it should be remembered that absorption of organic lead compounds, whether acute or for prolonged periods at a lower rate, induces acute intoxication of the central nervous system and adverse blood effects. Exposure limits are the OSHA PEL of 0.075 mg/m^3, the ACGIH TLV of 0.1 mg/m^3, and the NIOSH REL of 0.075 mg/m^3.

3.1.2.4 Trichloroethylene (TCE)

Trichloroethylene (TCE) is a non-flammable, mobile liquid with a characteristic odor reminiscent of chloroform. TCE vapor is heavier than air and

accumulates in depressions. The density of TCE is higher than that of water, which makes it a dense non-aqueous phase liquid (DNAPL).

TCE dissolves most fixed and volatile oils, and is used as a solvent for fats, resins, waxes, oils rubber paints, and varnishes. Its use includes degreasing, solvent extraction, and dry cleaning, as well as organic chemical and pharmaceutical manufacture. It is also used as an anaesthetic by inhalation.

The potential symptoms of overexposure are headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, irritation of the eyes, dermatitis, cardiac arrhythmias, and paraesthesia. It is also a potential occupational carcinogen. Exposure limits are the OSHA TWA of 50 ppm or 270 mg/m^3, and the OSHA STEL of 200 ppm or 1080 mg/m^3.

3.2 SPILL BACKGROUND

Plans documenting the replacement or repair of POL lines, valve pits, and hydrants date as far back as 1968, indicating that the JP-4 release may be as old as 30 years. A minimum age of the JP-4 release is given by the conversion date from JP-4 to JP-8, which was in June and July of 1992 (pers. comm. Master Sergeant (MSgt) T. Carter of LFM). Therefore, the JP-4 release dates between six to thirty years and the JP-8 release dates between zero to six years.

The contamination at Hydrant 1 in the area of P1B was detected during a drilling program commenced in 1983 by Ernest K. Hirata, Associates (Hirata 1983). However, the same investigation did not find any contamination in the area between Hydrant 1 and 2, which was found to be contaminated with both JP-4 and JP-8 during a 1996 subsurface investigation (BES, 1997).

In the early 1990's, contaminated soil was discovered during an upgrade construction project between HCP1 and Hydrant P1B, which is in the same vicinity as the contamination found in 1983. No documentation regarding the extent and type of the contamination discovered during construction is available.

In 1994, the fuel lines near Hydrant Control Pit 3 failed a tightness test. The system also failed a retest, although there is no visual evidence of a release or documentation supporting any fuel loss, neither from the 1983 nor the 1996 subsurface investigations. Concern has also been expressed over possible leakage from the trunk line between Hydrant Control Pit 1 and 4.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02741

HOT-MIX ASPHALT (HMA) FOR ROADS

-- End of Section Table of Contents --

SECTION 02741

HOT-MIX ASPHALT (HMA) FOR ROADS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP 1	(1998)Provisional Specification for Performance Graded Asphalt Binder
AASHTO MP 2	(1998; Interim 1999) Superpave Volumetric Mix Design
AASHTO TP53	(1998; Interim 1999) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method
AASHTO T182	(1984; R1993) Coating and Stripping of Bitumen-Aggregate Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 566	(1997) Evaporable Total Moisture Content of Aggregate by Drying
ASTM C 1252	(1998) Uncompacted Void Content of Fine

	Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM D 140	(1998) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous Paving Mixtures
ASTM D 995	(1995b) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985)) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	(1995) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	(1984; R 1994el) Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(1996el) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixture
ASTM D 2950	(1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3665	(1999) Random Sampling of Construction Materials
ASTM D 3666	(1998) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	(1994el)Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

ASPHALT INSTITUTE (AI)

AI MS-2	(1997) Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
AI MS-22	(1998; 2nd Edition) Construction of Hot-Mix Asphalt Pavements

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G

Proposed JMF.

Contractor Quality Control; G

Quality control plan.

Material Acceptance; G

Acceptance test results and pay calculations.

SD-04 Samples

Asphalt Cement Binder

5 gallon sample for mix design verification.

Aggregates; G

Sufficient materials to produce 200 lb of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates

QC Monitoring

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder

Copies of certified test data.

Testing Laboratory

Certification of compliance.

Plant Scale Calibration Certification

1.4 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.5 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not

be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.6 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.6.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.6.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.7 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.8 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of basaltic, sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter, cinders, clay balls, and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

a. The percentage of loss shall not be greater than 30 percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The percentage of loss shall not be greater than 9 percent after five cycles when tested in accordance with ASTM C 88 using sodium sulfate.

c. At least 90 percent by weight of the material retained on the No. 4 sieve shall consist of crushed particles. At least 70 percent of the material passing the No. 4 sieve and retained on the No. 8 sieve shall consist of crushed particles. A crushed particle is one having at least one mechanically fractured face.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 25 percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

2.1.2 Fine Aggregate

Fine aggregate shall consist of basaltic, clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. All individual fine aggregate sources shall have a sand equivalent value not less than 50 when tested in accordance with ASTM D 2419.

The fine aggregate portion of the blended aggregate shall have an uncompacted void content not less than 43.0 percent when tested in accordance with ASTM C 1252 Method A.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradation specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

Sieve Size, inch	Binder Course Percent Passing by Mass	Surface Course Percent Passing by Mass
1.25	100	---
1	85-100	---
3/4	---	---
1/2	60-85	85-100
3/8	---	72-88
No. 4	36-55	48-66
No. 8	26-41	32-48
No. 16	17-32	21-37
No. 30	12-25	15-27
No. 50	8-18	9-21
No. 100	5-14	8-17
No. 200	1-8	4-10

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO MP 1 Performance Grade (PG) 70-16. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be

furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-2 and the criteria shown in Table 3. The bituminous film retention shall be above 95 percent when tested in accordance with AASHTO T182. The Contractor may use aggregates not meeting the requirements of the stripping test for bituminous pavement provided a chemical additive is used resulting in a bituminous film retention above 95 percent. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

At the option of the contractor a currently used DOT superpave hot mix may be used in lieu of developing a new hot mix design study as described herein. The superpave volumetric mix shall be designed in accordance with AASHTO MP 2.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the

mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with 2 or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Bituminous film retention (stripping).

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Marshall Design Criteria

Test Property	75 Blow Mix
Stability, pounds minimum	*1800
Flow, 0.01 inch	8-16
Air voids, percent	3-5
Percent Voids in mineral aggregate VMA, (minimum)	
Binder Course	12.0
Surface Course	14.0
Bituminous Film Retention (Stripping)	96
Bituminous Binder Contents Limit (% of Dry Weight of Total Aggregate)	

Table 3. Marshall Design Criteria

Test Property	75 Blow Mix
Binder Course	4.0-6.5
Surface Course	4.5-6.6

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.
** Calculate VMA in accordance with AI MS-2, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory JMF design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 4. Field (Plant) Established JMF Tolerances

Sieves	Adjustments (plus or minus)
No. 4	7%
No. 8 to No. 100 (inclusive)	4%
No. 200	2%
Binder Content	0.40%
Temperature	20°F

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; while not desirable, this is acceptable.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-2 and AI MS-22. The job mix shall meet the requirements of paragraph MIX DESIGN. The amount of RAP shall not exceed 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP

shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the dynamic shear rheometer at high temperature and bending beam at low temperature requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 350 degrees F when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A prime coat and/or tack coat shall be applied in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 250 - 500 feet long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	12 (Binder Course) 14 (Surface Course) minimum
Stability, pounds (Average of 3 specimens)	1800 minimum
Flow, 0.01 inches (Average of 3 specimens)	8 - 16

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Mat Density, Percent of Marshall (Average of 4 Random Cores)	97.0 - 100.5
Joint Density, Percent of Marshall (Average of 4 Random Cores)	95.5 - 100.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements.

Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to

placing material at the joint. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a minimum of 2 inches from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials. Include monitoring plans on how this will eliminate clayballs and cinders in mix.

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l. Surface Smoothness

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at

the plant or job site. The laboratory shall meet the requirements as required in ASTM D 3666. The effective working area of the laboratory shall be a minimum of 150 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 degrees F plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program. The test frequency to be used shall be based on a "lot" basis quantity which shall be considered to be eight (8) hours of production or maximum of **1000** square yards of pavement placed, whichever is less.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per "lot" basis by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53or ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per "lot" basis from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per "lot" basis, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per "lot" basis in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per "lot" basis in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per "lot" basis and compacted into specimens, using 75 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct a minimum of four (4) in-place density tests per "lot" basis and any additional testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct continuous checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Running Average of Individual Samples		Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum)				

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Running Average of Individual Samples		Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
75 Blow JMF Flow, 0.01 inches	1800	1700	1900	1800
75 Blow	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3

3.11 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Test results shall be forwarded daily to the Contracting Officer. Exceptions or adjustments to pavement not meeting all acceptance criteria will not be made or allowed.

3.11.1 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government.

3.11.2 Laboratory Air Voids

Laboratory air voids will be calculated by determining the Marshall density of each lab compacted specimen using ASTM D 2726. All laboratory air void tests will be completed and reported daily within 24 hours after completion of construction. Maximum allowed laboratory air void shall be 0.60.

3.11.3 In-place Density

3.11.3.1 General Density Requirements

For determining in-place density, random cores will be taken at a location determined by the Government. Each random core will be full thickness of the layer being placed. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.3.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average Marshall density for the lot. The Marshall density will be determined as the average Marshall density of the four random samples (3 specimens compacted per sample). All density results for a lot will be completed and reported within 24 hours after the construction of that lot. Allowable range of average (4 core) in-place mat density shall be between 97.9 and 100.0. Minimum average (4 sample) joint density shall be 96.4.

3.11.4 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. In areas where the grade exceeds the tolerance, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.5 Surface Smoothness

The Contractor shall use the following method to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.5.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the tolerances specified in Table 7 when checked with an approved 12 foot straightedge.

Table 7. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
All paved areas	Longitudinal	1/4
	Transverse	1/4

3.11.5.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 25 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

-- End of Section --

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DIVISION 02 - SITE WORK

SECTION 02749

HOT-MIX ASPHALT (HMA) FOR AIRFIELDS

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SECTION 02749

HOT-MIX ASPHALT (HMA) FOR AIRFIELDS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP1	(1997)Performance Graded Asphalt Binder
AASHTO TP53	(1995) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method
AASHTO T182	(1984; R1993) Coating and Stripping of Bitumen-Aggregate Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1998) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 1252	(1998) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous

	Paving Mixtures
ASTM D 995	(1995b) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	(1995) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	(1984; R 1994) Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(1996a) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixture
ASTM D 2950	(1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3203	(1994) Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 3665	(1994) Random Sampling of Construction Materials
ASTM D 3666	(1996a) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	(1994) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5444	(1994) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1999) Asphalt Content of Hot Mix Asphalt by Ignition Method

ASPHALT INSTITUTE (AI)

AI MS-2	(1994) Mix Design Methods for Asphalt

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G

Proposed JMF.

Contractor Quality Control; G

Quality control plan.

SD-04 Samples

Asphalt Cement Binder

5 gallon sample for mix design verification.

Aggregates

Sufficient materials to produce 200 lb of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates; G
QC Monitoring; G

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder

Copies of certified test data.

Testing Laboratory

Certification of compliance.

1.4 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.5 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.6 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.6.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.6.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.7 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.8 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of basaltic, sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter, cinders, clayballs, and other deleterious substances. The coarse aggregate particles shall meet the following requirements:

a. The percentage of loss shall not be greater than 30 percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The percentage of loss shall not be greater than 9 percent after five cycles when tested in accordance with ASTM C 88 using sodium sulfate.

c. At least 90 percent by weight of the material retained on the No. 4 sieve shall consist of crushed particles. At least 70 percent of the material passing the No. 4 sieve and retained on the No. 8 sieve shall consist of crushed particles. A crushed particle is one having at least one mechanically fractured face.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 25 percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

2.1.2 Fine Aggregate

Fine aggregate shall consist of basaltic, clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls or cinders. The fine aggregate particles shall meet the following requirements:

a. The individual fine aggregate sources shall have a sand equivalent value greater than 50 when tested in accordance with ASTM D 2419.

b. The fine aggregate portion of the blended aggregate shall have an uncompacted void content greater than 45.0 percent when tested in accordance with ASTM C 1252 Method A.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of

ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

Sieve Size, inch	Binder Course Percent Passing by Mass	Surface Course Percent Passing by Mass
1.25	100	---
1	85-100	100
3/4	---	90-100
1/2	60-85	70-90
3/8	---	---
No. 4	36-55	40-57
No. 8	26-41	30-47
No. 16	17-32	20-36
No. 30	12-25	16-28
No. 50	8-18	10-22
No. 100	5-14	8-17
No. 200	1-8	4-10

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO MP1 Performance Grade (PG) 70-16. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-2 and the criteria shown in Table 3. The bituminous film

retention shall be above 95 percent when tested in accordance with AASHTO T182. The Contractor may use aggregates not meeting the requirements of the stripping test for bituminous pavement provided a chemical additive is used resulting in a bituminous film retention above 95 percent. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with two or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Bituminous film retention (stripping).

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

Table 3. Marshall Design Criteria

Test Property	75 Blow Mix
Stability, pounds minimum	*1800
Flow, 0.01 inch	8-16
Air voids, percent	3-5
Percent Voids in mineral aggregate (minimum)	See Table 4
Bituminous Film Retention (stripping) minimum percent	96
Bituminous Binder Content Limits (% of Dry Weight of Total Aggregate)	
Binder Course	4.0-6.5
Surface Course	4.5-6.5

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

Table 4. Minimum Percent Voids in Mineral Aggregate (VMA)**

Aggregate (See Table 2)	Minimum VMA, percent
Binder Course	12.0
Surface Course	13.0

** Calculate VMA in accordance with AI MS-2, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be limited to plus or minus 3 percent on the 1/2 inch, No. 4, and No. 8 sieves; plus or minus 1.0 percent on the No. 200 sieve; and plus or minus 0.40 percent binder content. If adjustments are needed that exceed these limits, a new mix

design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; this is acceptable.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 350 degrees F when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A prime coat and/or tack coat shall be applied in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 250 - 500 feet long and two paver passes wide placed in two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment

used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed.

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	12.0 (Binder Course) 13.0 (Surface Course) minimum
Stability, pounds (Average of 3 specimens)	1800 minimum
Flow, 0.01 inches (Average of 3 specimens)	8 - 16
Mat Density, Percent of Marshall (Average of 4 Random Cores)	97.0 - 100.5
Joint Density, Percent of Marshall (Average of 4 Random Cores)	95.5 - 100.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF and for Government acceptance testing shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10

feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor, with the exception that the Contractor shall not apply more than three passes with a vibratory roller in the vibrating mode. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing the adjacent lane), or otherwise defective, shall be cut back a minimum of 2 inches from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth

of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials. Include monitoring plans and how this will eliminate clayballs and cinders in the mix.

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l. Surface Smoothness

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant or job site. The effective working area of the laboratory shall be a minimum of 150 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 degrees F plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment,

supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program. The test frequency to be used shall be based on a "lot" basis quantity which shall be considered to be eight (8) hours of production or a maximum of **1000** square yards of pavement placed, whichever is less.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per "lot" basis by one of the following methods: extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53, ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per "lot" basis from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per "lot" basis, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per "lot" basis in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per "lot" basis in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per "lot" basis and compacted into specimens, using 75 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct a minimum of four (4) in-place density tests per "lot" basis and any additional testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct continuous checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and

shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Individual Samples		Running Average of Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum)	1800	1700	1900	1800
Flow, 0.01 inches	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3

3.11 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Exceptions or adjustments to pavement

not meeting all acceptance criteria will not be made or allowed.

3.11.1 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government.

3.11.2 Laboratory Air Voids

Laboratory air voids will be calculated in accordance with ASTM D 3203 by determining the Marshall density of each lab compacted specimen using ASTM D 2726. All laboratory air void tests will be completed and reported daily within 24 hours after completion of construction. Maximum allowed laboratory air void shall be 0.60.

3.11.3 In-place Density

3.11.3.1 General Density Requirements

For determining in-place density, random cores will be taken at a location determined by the Government. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.3.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average Marshall density for the lot. The Marshall density will be determined as the average Marshall density of the four random samples (3 specimens compacted per sample). All density results for a lot will be completed and reported within 24 hours after the construction of that lot. Allowable range of average (4 core) in-place mat density shall be between 97.9 and 100.0. Minimum average (4 sample) joint density shall be 96.4.

3.11.4 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.03 foot for runways or 0.05 foot for taxiways and aprons from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. In areas where the grade exceeds the tolerance, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government.

Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.5 Surface Smoothness

The Contractor shall use the following method to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.5.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 7 when checked with an approved 12 foot straightedge.

Table 7. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
Taxiways	Longitudinal	1/8
	Transverse	1/4
Calibration hardstands and compass swinging bases	Longitudinal	1/8
	Transverse	1/8
All other airfields and helicopter paved areas	Longitudinal	1/4
	Transverse	1/4

3.11.5.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the

pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15050

MECHANICAL EQUIPMENT, FUELING

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GUIDE SPECIFICATION FOR CONSTRUCTION

SECTION 15050

MECHANICAL EQUIPMENT, FUELING

PART 1 GENERAL

1.1 REFERENCES

Waiver to Use MilStds and MilSpecs in Air Force Fuel Projects, HQ AFCESA/CESM (01/29/96).

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B40.1	(1991) Gauges--Pressure Indicating Dial Type--Elastic Element

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1615	(1996) Installation of Underground Petroleum Storage Systems
API STD 2000	(1992) Venting Atmospheric and Low Pressure Storage Tanks (Nonrefrigerated and Refrigerated)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 182/A 182M	(2000) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings and Valves and Parts for High-Temperature Service
ASTM C 827	(1987) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 40 CFR Part 280	Underground Storage Tanks; Technical Requirements and State Program Approval, Final Rules

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1990) Flammable and Combustible Liquids Code
NFPA 70	(1996) National Electric Code

MILITARY SPECIFICATIONS (MS)

MS MIL-P-24441	(Rev. B, 1991; Supp. 1) General Specification for Paint, Epoxy - Polyamide
MS MIL-T-83133	(Rev. C, 1990; Amend. 1) Turbine Fuels, Aviation, Kerosene Types, NATO F-34(JP-8) and NATO F-35

MILITARY STANDARDS (MIL-STD)

MIL-STD-130	(Rev. G, 1988) Identification Marking of U.S. Military Property
MIL-STD-161	(Rev. F, 1985; Notice 2) Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3275A	(1994) Acrylonitrile Butadiene (NRB) Rubber Sheet, Non-Asbestos Fiber Fuel and Oil Resistant

STEEL TANK INSTITUTE (STI)

STI P3	(1987) Exterior Corrosion Protection of Underground Steel Storage Tanks

UNDERWRITERS LABORATORIES (UL)

UL 58	(1986) Steel Underground Tanks for Flammable and Combustible Liquids

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pressure Gages; G

Automatic Pump Controls; G

Meters; G

Product Recovery Tank and Accessories; G

Hydrant Outlet Pits; G

Isolation Valve Pits; G

High Point Vent Pits; G

Low Point Drain Pits; G

Operating Tank Level Switches; G

Water Draw-Off System; G

Venturi Tubes; G

Differential Pressure Transmitter; G

Unloading Level Switches; G

SD-02 Shop Drawings

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the equipment and systems.

Meters; G

Venturi Tubes; G

Water Draw-off System; G

Product Recovery Tank and Accessories; G

Hydrant Outlet Pits; G

Isolation Valve Pits; G

High Point Vent Pits; G

Low Point Drain Pits; G

Product Recovery Tank ; G

Provide the product recovery tank drawings as one package with the design analysis. Shop fabrication drawings shall include type of material, configuration, thickness, and necessary details of construction of the steel tank and vault. Shop drawings shall also show the steel grating and supports.

SD-06 Test Reports

Tank Tightness Test Reports; G

Leak Detection Monitor; G

SD-07 Certificates

System Supplier Qualifications and Experience Statement; G

Valve List; G

Coating; G

U.L. Labeled; G

STI P3 Label; G

Hydrant Outlet Pits; G

Isolation Valve Pits; G

High Point Vent Pits; G

Low Point Drain Pits; G

Hydrant Outlet Frame and Cover; G

Isolation Valve Frame and Cover; G

High Point Vent Frame and Cover; G

Low Point Drain Frame and Cover; G

SD-10 Operation and Maintenance Data

Operation and maintenance information shall be submitted for the equipment items or systems listed below. Refer to Section 01730 FACILITY OPERATION AND MAINTENANCE MANUAL for the information to be submitted for various type of equipment and systems.

Pressure Gages

Automatic Pump Controls

Pressure Indicating Transmitters

Unloading Level Switches

Flow Switches

Venturi Tubes

Differential Pressure Transmitter

Meters

Orifice Meter

Hydrant Outlet Pits

Isolation Valve Pits

High Point Vent Pits

Low Point Drain Pits

Product Recovery Tank and Accessories

Water Draw-off System

PART 2 PRODUCTS

2.1 DESIGN CONDITIONS

Components shall be suitable for use with JP-8 turbine fuel; specific gravity 0.81 at 60 degrees F., viscosity 1.62 CS at 60 degrees F., Reid vapor pressure less than 0.05 psi, MS MIL-T-83133. Components to be ANSI Class 150 (275 PSIG at 100 degrees F.) unless noted otherwise. Components to be suitable for outside, unsheltered location, and to function normally in ambient temperatures between 63 degrees F. and 86 degrees F.

2.2 COMPOSITION OF MATERIALS

Materials in contact with the fuel shall be noncorrosive. No zinc-coated metals, brass, bronze, iron, lead or lead alloys, copper or copper alloys, or other light metal alloys containing more than 4% copper shall be used in contact with the fuel.

2.3 ELECTRICAL WORK

Motors, manual or automatic motor control equipment except where installed in motor control centers, and protective or signal devices required for the operation specified herein shall be provided under this section in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Any wiring required for the operation specified herein, but not shown on the electrical plans, shall be provided under this section in accordance with Section 16415 ELECTRICAL WORK, INTERIOR.

2.4 MATERIALS AND EQUIPMENT

All items of material and equipment shall be new and of the best quality used for the purpose in commercial practice and shall be products of reputable manufacturers. Each major component of equipment shall have the manufacturer's name, address and catalog number on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent only will not be acceptable. The gears, couplings, projecting set screws, keys and other rotating parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded. Equipment, assemblies and parts shall be marked for identification in accordance with MIL-STD-130 and MIL-STD-161. Valve identification tags made of brass, stainless steel,

or engraved anodized aluminum, indicating valve number and normally open (NO) or normally closed (NC) shall be installed on valves. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No 12 AWG, copper wire, stainless or aluminum hanging wires, or chrome-plated beaded chain designed for that purpose. Submit valve list with valve type, valve identification number and location.

2.4.1 System Supplier

The entire fuel delivery system, including but not limited to pumps, pump control panel, filter separators, computer hardware and software, venturi tubes, transmitters, hydraulic control valves, and all field instrumentation, shall be furnished by a single system supplier, henceforth referred to as "Supplier", that is regularly engaged in the supplying of such equipment for aircraft hydrant refueling system construction. The Supplier shall be responsible to the contractor for satisfactory start-up and operation of the entire system, and shall assist the Contractor to ensure proper installation of all piping, mechanical equipment and controls. Deviations from these specified Supplier responsibilities will not be accepted. Provide a System Supplier Qualifications and Experience Statement. The Supplier shall also be responsible to the contractor for Scheduling all Contractor, Sub-Contractor and manufacturer's service personnel during system start-up and final commissioning (Section 15899).

a. The Supplier shall be the designer, builder, installer and programmer of the Pump Control and Annunciation System.

b. The Supplier shall review contract drawings and specifications, and identify design problems, deficiencies and/or enhancements for Government review, prior to ordering materials and equipment.

c. The Supplier shall communicate with the Major Command Fuels Engineer, construction agent, and Architect-Engineers, to clearly understand the design intent and to verify that all design expectations are achievable. The Supplier shall also communicate with the system operators regarding auxiliary equipment intended for use with the system (refueling trucks, hydrant hose carts, hydrant servicing vehicles, portable pantographs, etc), and verify system compatibility and proper calibration settings.

d. The Supplier shall provide and integrate suitable components (regardless of manufacturer) to provide an efficient, accurate repeatable and reliable system that meets all specified performance characteristics.

e. The Supplier shall work with the Contractor and Sub-Contractors to ensure that equipment and materials are stored and installed properly to prevent damage, minimize air entrapment, and maintain cleanliness of the installed system.

f. The Supplier shall work closely with both mechanical and electrical subcontractors to insure proper installation of equipment, instrumentation, wiring and coordination between trades.

g. The Supplier shall work closely with the Contractor during system start-up and commissioning activities per Section 15899, FUELING SYSTEMS START-UP. The Supplier shall conduct and on-site verification of proper equipment installation, programming, wiring, calibration, set-point adjustments, hydraulic control settings, pressure relief settings, alarm settings, etc, prior to initial fuel receipt. The Supplier shall assist the Contractor with developing the System Start-up Plan, shall coordinate the work of manufacturer's field technicians, shall over system performance tests and final performance demonstration, and provide a 7-channel recorder to plot the system profile during those operations. The Supplier shall also coordinate government-provided equipment and manpower support for start-up and commissioning activities.

h. The Supplier shall provide equipment data for inclusion in the Operations and Maintenance Manuals for the project per Section 01730, OPERATION AND MAINTENANCE SUPPORT INFORMATION (OMSI) which is clear and detailed enough to facilitate both installation and maintenance.

i. The Supplier shall participate in Contractor-provided training on the system per Section 01730, OPERATION AND MAINTENANCE SUPPORT INFORMATION (OMSI) to insure that Government operators and maintenance personnel are proficient in their respective areas of responsibility prior to system acceptance. As a minimum, the Supplier shall provide training on the control system (computer hardware, computer software, electronics sensors and transmitters, auto control valves, etc) that enables the Base Liquid Fuels Maintenance Shop to properly accomplish maintenance, annual calibrations, diagnostic testing, troubleshooting, and repairs.

2.5 PRESSURE GAGES

Pressure gages shall conform to ASME B40.1 with metal cases and 4-inch diameter white dials. Gages shall be bottom connected, without back flanges. A pulsation dampener, adjustable to the degree of dampening required, shall be provided for each gage. Range of gages shall be as indicated. A ball valve shall be provided for each pressure gage. Gages shall have all parts immersed in silicone oil. Gages shall be labeled with the calibration date. Range for each pressure gage is as indicated on the drawings.

2.6 GASKETS

Gaskets shall be in accordance with Section 15060 PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM.

2.7 BOLTS AND NUTS

Bolts and nuts shall be in accordance with Section 15060 PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM.

2.8 AUTOMATIC PUMP CONTROLS

The pressure and flow transmitters specified in this paragraph shall be obtained from a single supplier of such products. The same supplier shall also furnish the associated venturi tubes and GPM meter. The supplier shall be responsible for furnishing components that are compatible and that operate as a system to perform the required pump control functions. Control tubing between controls/instruments and fuel lines shall be installed to eliminate air entrapment. Control tubing shall be as specified in Section 15060 PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM. Each item of equipment specified hereafter shall have manufacturer's authorized service personnel present to assist in PERFORMANCE TESTING as specified in Section 15899 FUELING SYSTEMS START-UP. Items specified under this paragraph shall be submitted for approval concurrently with items specified in Section 15970 PUMP CONTROL AND ANNUNCIATION SYSTEM.

2.8.1 Pressure Indicating Transmitters

Pressure indicating transmitters shall consist of a capacitance sensor operating on a differential in pressure of fuel (one side being open to atmospheric pressure). The output shall be a 4 - 20 mA dc, linear signal between 0 - 100% of the input. It simultaneously will produce a digital HART (Highway Addressable Remote Transducer) output signal. Loop power shall be provided from remote power supply located in the pump control panel (PCP).

a. Transmitter body shall be stainless steel with stainless steel diaphragm capsule process connecting to a 1/2 inch NPT. Drain and vent valves to be stainless steel. Accuracy shall be $\pm$ 20 percent of calibrated span including combined effects of linearity, hysteresis and repeatability.

b. One pressure indicating dial shall be supplied with each pair of transmitters. Pressure indicating dials shall consist of a bellows type pressure sensing element operating on a differential in pressure of fuel (one side being open to atmospheric pressure) and a mechanical indicator (driven by the bellows unit). The bellows shall be dual opposed, liquid filled, rupture-proof type with bellows movement converted to rotation and transmitted by a torque tube. Bellows housing shall be stainless steel and shall have a rated working pressure of not less than 500 psi with a minimum differential pressure range of 0 to 250 psi. Liquid used to fill the bellows shall be suitable for the expected minimum ambient temperature. The indicating dial shall be at least 6 inches in diameter with a weatherproof glass cover. The case shall be finished with a weather resistant epoxy resin enamel. The indicating pointer shall traverse a 270 degrees arc. The scales shall be graduated over the selected pressure ranges so that the pressure can be read in pounds per square inch gage (psig). Indicator accuracy shall be 0.75 percent of full scale. Pressure indicating dial shall be provided with suitable over-range protection.

c. Pressure transmitters shall be UL, FM, or CSA listed for Class 1, Division 1, Group D hazardous environment as defined by NFPA 70,

with maximum temperature rating T2D (419 degrees F). Each transmitter and dial shall be supplied with a factory assembled two valve stainless steel manifold. Vent valves shall be furnished on upper ports of each transmitter and dial. Pressure transmitters and the indicating dial shall be suitable for mounting on a 2-inch pipe stand. Complete installation shall be in accordance with manufacturer's recommendations.

d. Provide a HART (Highway Addressable Remote Transducer) protocol interface handheld calibration device.

2.8.2 Flow Switches

Switches shall be actuating vane type flow switch with single adjustable set-point. Switches shall mount on ASME B16.5 Class 150 raised face flange. Provide snap action switch mechanism U.L. listed for Class I, Division 1, Group D hazardous locations. Switches to be double pole double throw (DPDT). Switch power shall be 120 volts, single phase, 60 hertz, 10 amps minimum.

2.8.3 Venturi Tubes

a. The venturi tubes shall be provided in conjunction with Section 15970 PUMP CONTROL AND ANNUNCIATION SYSTEM.

b. Start-up, adjustments and calibration, and instruction of personnel in the operation and maintenance of the venturi tubes shall be considered as a required portion of the controls package.

c. The venturi tubes shall be low loss differential pressure producers consisting of a short housing piece and a fully machined, contoured throat section providing a restriction at the center, with both inlet approach and exit having geometrically symmetrical curves. They shall be velocity head, impact, differential producing devices designed to measure differential pressure of JP-8 fuel. They shall be constructed of 304L stainless steel with ANSI Class 150 flanges on each end and be suitable for operation of 275 psig at 100 degrees F. They shall be of sufficient thickness to with-stand the same stresses as the upstream and downstream piping. Each venturi tube shall have a minimum of four 1/2-inch connections. An individual head-capacity curve shall be furnished for each venturi tube.

d. Operating conditions for the venturi tubes shall be as follows:

(1) Issue Venturi Tube. Minimum inlet-to-throat differential pressure at 3,000 gpm: 200 in. H2O.

(2) Return Venturi Tube. Minimum inlet-to-throat differential pressure at 600 gpm: 200 in. H2O.

(3) Venturi tubes discharge coefficient "C" to be greater than or equal to 0.97 over pipe Reynolds number range

between 200,000 and 1,000,000 and shall be independent of Beta over a Beta range of 0.4 to 0.75. Pressure loss shall be less than 24 percent of differential pressure generated by the venturi tube. Repeatability of the discharge coefficient "C" shall be 2 percent for Reynolds number range of 10,000 to 1,000,000.

(4) Provide two portable GPM Meters, one for each size of venturi. The meters shall be complete with valves, hoses and connecting disconnects, and carrying case. The meters shall have stainless steel bellows, mounting bracket, 500 psi swp, 6-inch dial with 270 degrees arc. Dial shall read GPM Jet Fuel. Range of scale shall be 1.5 times GPM flow requirement. The venturi manufacturer shall provide the portable meters with the venturi in order to be compatible. The venturi tubes shall also be provided with a suitable table to convert inches differential pressure to gallons per minute.

2.8.4 Differential Pressure Transmitter

Differential pressure transmitter shall consist of a capacitance sensor operating on a differential in pressure of fuel. The output shall be a 4 - 20mA dc, square root signal between a minimum of 4 - 100% of the input. It may be linear between 0 - 4%. It simultaneously will produce a digital HART (Highway Addressable Remote Transducer) output signal. Loop power shall be provided from remote power supply located in the pump control panel (PCP).

a. Transmitter body shall be stainless steel with stainless steel diaphragm capsule process connecting to a 1/2 inch NPT. Drain and vent valves to be stainless steel. Accuracy shall be " 0.20 percent of calibrated span including combined effects of linearity, hysteresis and repeatability.

b. One differential pressure dial shall be supplied with each pair of transmitters. Differential pressure dial shall consist of a bellows type pressure sensing element, operating on a differential in pressure of fuel, and a mechanical indicator, driven by the bellows unit. The bellows shall be dual opposed, liquid filled, rupture-proof type with bellows movement converted to rotation and transmitted by a torque tube. Displacement of bellows shall be 1.5 cubic inches for full scale travel. Bellows housing shall be stainless steel and shall have a rated working pressure of not less than 500 psi. Liquid used to fill the bellows shall be suitable for the expected minimum ambient temperature. The indicating dial shall be at least 6 inches in diameter with a weatherproof glass cover. The case shall be finished with a weather resistant epoxy resin enamel. The indicating pointer shall traverse a 270 degree arc. The scales shall be graduated over the selected pressure ranges so that the flow rate can be accurately read in gallons per minute. Indicator accuracy shall be 0.5 percent of full scale. Differential pressure indicating

dial shall be provided with built-in pulsation damper and suitable over-range protection.

c. Differential pressure ranges shall be selected as necessary to operate in conjunction with associated venturi tube:

(1) Issue Venturi Tube - 0 to 3000 GPM (full range)

(2) Return Venturi Tube - 0 to 800 (full range)

Each venturi tube shall have two transmitters and one indicating dial per function and shall be installed as indicated on the drawings.

d. Differential pressure transmitters shall be UL, FM, or CSA listed for Class 1, Division 1, Group D hazardous environment as defined by NFPA 70, with maximum temperature rating T2D (419 degrees F). Each transmitter and indicating dial shall be supplied with a factory assembled five valve stainless steel manifold. Vent valves shall be furnished on upper ports of each transmitter and indicating dial. Differential pressure transmitters and the indicating dial shall be suitable for mounting on a 2-inch pipe stand. Complete installation shall be in accordance with manufacturer's recommendations. Provide calibration meter for differential pressure transmittals.

2.9 METERS

Meter shall be a one-way flow, positive displacement type meter designed for a continuous flow of 600 GPM at the truck fill stand. Meter shall have ANSI Class 150 flanges and body working pressure of not less than 200 psig and shall be suitable for hydrostatic testing of 275 psig. Meter shall be factory calibrated for JP-8 jet fuel and capable of being calibrated in the field. The register shall have a non-setback total indicator and a setback type run indicator so that individual runs can be registered without affecting the total of all runs as shown on the indicator. The total indicator shall have a minimum of seven figures and the setback run indicator shall have a minimum of six figures. The register shall read in gallons and the smallest unit of indicated delivery shall be 1 gallon. Accuracy shall be within +0.3 percent between ten percent and maximum rated flow. Provide temperature volume compensation for the register. Provide a ticket printer with Zero Start. Meters shall be provided with a suitable drain at the bottom, equipped with a ball valve.

2.9.1 Pressure Loss

Pressure loss through the meter shall not exceed 3 psi at 600 gpm flow rate.

2.9.2 Materials of Construction

Materials of construction shall be stainless steel, aluminum or nonferrous material except meter case may be steel with electrolyses nickel plated internals coated to 3 mil thickness. No ferrous or zinc-coated material bronze, brass or other copper bearing alloys shall be used in contact with

the fuel.

2.10 ORIFICE METER

Provide a 4-inch orifice meter complete with a local electronic display in gallons per minute. The orifice flanges shall be stainless steel in accordance with ASTM A 182/A 182M and meet the ANSI 150 lb. class. The orifice plate shall be 304/304L stainless steel and sized to measure flow rates from 700 gpm to 300 gpm. Differential pressure transmitter shall read the pressures from tapped point on the orifice flanges. Refer to paragraph 2.8.4 of this Section for requirements for differential pressure transmitter. Tubing to the transmitter shall be stainless steel. Provide a valve manifold with air venting and draining. Components in contact with the JP-8 shall be compatible with jet fuel.

2.11 PRODUCT RECOVERY TANK AND ACCESSORIES

2.11.1 Tank Construction

Product recovery tank shall be a U.L. labeled, double wall, steel tank, with interstitial monitor. Tank shall be provided with calibrated gage stick and strapping chart. Tank shall be provided with a steel vault attached to tank. Vault shall be provided with a rolling pit cover and removable access grating.

2.11.1.1 Steel Tank With Vault

a. The design, fabrication, erection, testing, and inspection of the double wall tank shall conform to the requirements of UL 58, Standard for Safety, Steel Underground Tanks for Flammable and Combustible Liquids, Type II. The exterior tank walls shall be separated from the interior walls by standoffs. Provide Drawings. Provide tank tightness test reports.

b. Tank manufacturer shall design the steel vault with the tank. The steel vault shall be 1/4-inch thick steel and designed to support the weight of the rolling cover.

c. Material shall be carbon steel plate.

d. Lifting lugs shall be located at the balance points.

e. Provide anchor straps to attach tank to hold down slab. Straps shall be separated from the tank by a pad made of inert insulating material. Number and location of straps shall be as indicated on the drawings.

f. Tank capacity, connections and appurtenance shall be as shown on the drawings and as described under "Monitor."

g. A complete system of cathodic protection shall be provided for the tank and vault in accordance with Section STI P3 System Requirements.

h. The interior and exterior surfaces of tank and vault shall be coated for corrosion protection. The interior surface shall be coated in

accordance with MS MIL-P-24441, Formulas 150, 151, and 152. The exterior surface shall be coated in accordance with STI P3 and the tank shall bear the STI P3 label. Provide a test station between tank and anode.

2.11.1.2 Leak Detection Monitor

a. An annular space shall be provided between the primary and secondary shells to allow for the free flow and containment of all leaked product from the primary tank.

b. The tank shall be provided with a leak monitoring system capable of sensing leaks in the secondary containment space and in the vault. The system shall detect a leak of fuel through the inner shell to the area between the inner and outer shells or a leak of ground water through the outer shell into the area between the inner and outer shells. The detector and any equipment in the area of the fuel tanks and valve pits shall be intrinsically safe or explosion proof. The system shall be a continuous surveillance type. The sensor shall be intrinsically safe discriminating type and shall be connected to a remote panel. Totally flooded containment space reservoir system shall not be permitted. The panel shall provide an audible and visible alarm if a leak is detected and shall indicate if the leak is fuel or water. The alarm shall be manually reset at the panel. An inert gas that is heavier than air shall be used in containment space of the tanks to prevent the forming of condensation. Contractor shall provide instructions and equipment required for calibration of the monitoring system. Contractor shall also provide calibration maintenance schedule. Access shall be provided to the tank sensor for testing and maintenance. The control panel shall be located where shown on the plans. Remote alarm shall be provided at the pump control panel(PCP), see Section 15970, PUMP CONTROL AND ANNUNCIATOR SYSTEM. This control panel shall have a sign located adjacent to it indicating that the alarm indicates a leak in the fuel tank or the vault. The Contractor shall provide system operating instructions inside of the control panel.

c. Monitoring shall be continuous and shall be remotely indicated. The control console shall generate a visual and audible alarm and shall provide one DPDT contact closure on alarm for remote alarm annunciation.

2.11.1.3 Tank Appurtenances and Fittings

Tank appurtenances and fittings shall be provided as indicated. Nozzles for appurtenances and steel vault shall be as indicated or per manufacturer's recommendations and shall be installed plumb with all above grade flange faces level. Gravity fill line shall be provided with locking cap. The flange on the Product Recovery Pump pumpway shall be an ASME Class 150 flange.

2.11.1.4 Tank Vent

Tank vent shall be stainless steel pipe. Vent shall be a breather (pressure-vacuum) with hinged or guided pallets. Moving or striking parts shall be nonferrous metal. Design shall be such that moisture cannot collect on the pallet. Size pressure and vacuum relief vent in accordance with API STD 2000. Vent opening shall be covered with insect screen and

terminate 12 feet aboveground.

2.11.1.5 Manway

A 36-inch round manway shall have U.L. listed gasket with bolted cover. A fiberglass or stainless steel ladder shall be provided inside the tank at the manway.

2.11.1.6 Sampling and Gauging hatch

A sampling and gauging hatch shall be provided and shall consist of a foot-operated, hinged cover with a flexible sealing ring and provision for padlocking. The hatch shall be non-sparking and shall have a flanged connection for installation on 4-inch steel pipe. Provide a datum plate beneath gauge opening, and stencil reference height on gauge/sampling hatch piping.

2.11.1.7 Product Recovery Pump (PRP-1)

Refer to Section 15140 PUMPS, FUELING SYSTEM

2.11.1.8 Electric Pump

The electric pump shall be a sliding vane type rotary pump. The pump construction shall permit the removal of the rotor and sliding vanes without disconnecting the pump. Pump capacity shall be 5 gallons per minute with a 15 feet suction head and a discharge head of 25 feet. The pump and motor shall be mounted on a cast iron or steel subbase. The motor shall have sufficient power for the service required, shall be of a type approved by the pump manufacturer shall be suitable for available electric service, shall be totally enclosed, fan cooled, TEFC, and shall conform to the requirements specified in Section 16415, ELECTRICAL WORK, INTERIOR. Pump shall be provided with stainless suction screen, stainless steel pipe, and aluminum 1 1/2-inch cam type quick disconnect with dust cap.

2.11.1.9 Lockable Cap

A lockable cap shall be provided for the 2-inch gravity fill line.

2.11.1.10 Overfill Valve (OV-1)

Refer to Section 15101, CONTROL VALVES, FUELING SYSTEM

2.11.1.11 Tank Calibration

Provide a certified tank calibration chart in 1/8 inch increments reading in gallons.

2.12 HYDRANT OUTLET PITS AND ISOLATION VALVE PITS

Hydrant hose truck hydrant outlet pits and isolation valve pits shall be prefabricated units that are the standard products of a firm regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least (3) years prior to

bid opening. The basic pit shall consist of .50-inch-thick fiberglass walls and floor with main body dimensions as shown on the drawings. The pit shall contain twelve (minimum) integral concrete anchors or two integral anchors that run continuous on three sides of pit. The integral fiberglass top flange shall require no exposed corrosive material, weldments, or strongbacks within the pit to support the aluminum cover assembly. The manufacturer shall have had a minimum of three years successful experience in the production and usage of their fiberglass service pits and shall supply proof of experience at time of submittals. Pits shall be provided with a 2-inch pump-out line terminating with a male cam type bronze connector with female dustcap. Pits shall be provided with removable aluminum grating platform suitable for loading of 400 pounds per square foot. The grating shall cover the entire opening when the lid is in the open position.

2.12.1 Pit Cover

The pit cover assembly shall consist of a completely removable one-piece aluminum lid attached to a rigid frame which is an integral part of the fiberglass pit. The lid shall be attached to the frame with hinges which do not carry wheel loads applied to the top surface of the lid in its closed position. The lid shall be equipped with a device to hold the lid in its fully-opened position. This lid-staying device shall automatically engage when the lid is opened to its fully-opened position. The device shall also be provided with a quick-release mechanism designed to be operated with one hand. The lid shall be considered fully-open when it is rotated approximately 90 degrees from its closed position. Each cover lid shall move smoothly through its entire range of motion and shall be counterbalanced sufficiently to require an externally-applied opening force of 35 pounds (maximum) to be applied to the center of the long side of the cover (opposite the hinge side). Similarly, the maximum closing force required to be applied at the same point shall be approximately 50 pounds. In addition, the cover shall be counterbalanced in such a fashion that the cover will not close under its own weight if released when open to any angle greater than 70 degrees (from its closed position). Operation of the lid will not have spring assist. Lifting handles (two minimum) shall be provided for each lid. Each handle shall provide comfortable, secure grip for and average adult male's full (gloved) hand. All covers shall be provided with a latch, operable from the exterior of the vault, to securely hold the lid to the frame in the closed position. The latch will be capable of being released from either lifting handle. Tools shall not be required to engage (or disengage) the latch or the lid lifting handles. Latch and handle designs shall be weather-resistant with features to prelude freeze-up and the collection of dirt and precipitation. **The pit and cover assemblies shall present a surface which is 3 inches above the highest corner of the concrete slab upon completion of their installation.** Projections of the lid's hinges, lifting handles, or latches above the plane of the lid, whether temporary or permanent, shall not be allowed. The weight bearing flange surfaces of both the fiberglass pit liner and the aluminum cover lid shall be machined flat to assure uniform weight distribution. The word FUEL shall be integrally cast in raised letters on the top surface of each lid. The lettering shall be a minimum of 1-inch high and raised to 0.0625-inch.

2.12.2 Pit Cover Materials, Design, and Testing

All cover lids and frames shall be designed using an appropriate cast aluminum alloy or rolled aluminum plate to support an aircraft wheel load simulated by a roving 200,000-pound test-load applied perpendicular to a 200-square-inch contact area (10 inches by 20 inches) of the cover's top surface. The aluminum alloy material selected for design shall be ductile, corrosion-resistant, impact-resistant, and suitable for the intended use. All covers shall be non-skid surface construction and free of injurious defects. Welding for the purpose of structural repair of casting defects shall not be allowed. Minor cosmetic welding is acceptable. The cover shall be capable of supporting the test-load without failure regardless of the location or orientation of the load. Localized yielding or cracking or excessive deformations shall be considered as failure. Actual load-tests shall be performed on a minimum of 10 percent of all the covers supplied. Load-tested units shall be randomly selected. Load-test conditions shall model field-installed conditions as nearly as practicable. The 200 Kip test-load shall be applied to the cover for a minimum duration of 5 minutes. Absolute maximum deflection of the cover lid under the test-load shall not exceed 1/180th of the minimum interior opening dimension of the fiberglass pit body. Maximum deflection of the cover lids) remaining after removal of the test load shall be $\pm$ 0.010-inches to assure that no permanent set has taken place. Upon removal of the test-load, the cover lid and frame shall be carefully examined for cracks or localized areas of permanent deformation. All results shall be submitted for review and approval. A single failure to meet any of the stated criteria shall be considered sufficient grounds for the testing of 50 percent of the units. Provide test results from Hydrant Outlet Frame and Cover and Isolation Valve Frame and Cover. Provide a waterproof seal to prevent water from entering the pit through a closed lid.

2.12.3 Pipe Seal

The pipe penetrations through the pit wall shall be sealed by means of a Buna-N boot. The boot shall be secured to a metal collar welded to the pipe riser and to a steel pipe sleeve at the pit penetration by stainless steel clamps. Collar shall be fabricated from the same material as the pipe. Buna-N (Nitrile Butadiene) material shall be in accordance with SAE AMS 3275A.

2.12.4 Sleeve Seals

Sleeve seals indicated for sealing the annular space between pipe and pipe sleeves in concrete walls shall have sealing material resistant to brackish water and JP-8. Seals shall consist of an inner link type seal can be installed (or replaced) with the carrier pipe in place. All metal parts incorporated in the seal system shall be stainless steel. The seal system shall be capable of holding at least 10 psig of pressure without leaking.

2.12.5 Hydrant Outlet Pit Equipment

At the Contractor's option, hydrant pits may be furnished complete with hydrant control valves and shutoff valves assembled in a pipe riser. All valves and piping furnished by the pit manufacturer shall comply with the

requirements specified herein. Control valves are specified in Section 15101, CONTROL VALVES, FUELING SYSTEM. All control valves shall be of the same manufacturer. Piping, fittings, valves and etc. shall comply with Section 15060, PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM.

2.12.6 Isolation Valve Pit End Seal

End seals for isolation valve pits shall be furnished as shown on drawings. Provide polyethylene pipeline crossing insulator.

2.12.7 Isolation Valve Pit Equipment

At the Contractor's option, isolation valve pits may be furnished complete with isolation valves, high point vent valves or low point drain valves. All valves and piping furnished by the pit manufacturer shall comply with the requirements specified herein, piping, fittings, valves and etc. shall comply with Section 15060 PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM.

2.13 HIGH POINT VENT PITS AND LOW POINT DRAIN PITS

2.13.1 Pit Assembly

Each pit shall incorporate the following items built into a self-contained assembly.

2.13.2 Pit

The basic pit shall consist of 0.25-inch wall fiberglass liner with a main body approximately 23-inches in diameter and a minimum of 37-inches deep. The pit shall contain four integral concrete anchors. The fiberglass top flange shall require no exposed corrosive material, weldments, or strongbacks within the pit to support the cast aluminum ring and cover assembly. The pits shall be the standard products of a firm regularly engaged in the manufacture of such product and shall essentially duplicate items that have been in satisfactory use for at least three (3) years prior to bid opening. Proof of experience shall be submitted.

2.13.3 Pit Cover, General Requirements

The pit cover shall include a removable outer ring frame and an interior 23.5-inch diameter (clear opening) hinged lid that opens 180 degrees. Each cover lid shall move smoothly through it entire range of motion and shall require a maximum opening force of 25 pounds to be applied at a single lifting handle. Each handle shall provide a comfortable, secure grip for an average adult male's full gloved hand. Tools shall not be required to engage the lifting handle. Projections of the lid's hinges or handles above the plane of the lid, whether temporary or permanent, shall not be allowed. The pit service shall be integrally cast in raised letters on the top surface of each lid. The lettering shall be a minimum of 1-inch high and raised to 0.0625-inch. The weight bearing flanges of the fiberglass pit liner and the aluminum cover frame (and lid) shall be machined to assure uniform weight distribution.

2.13.4 Pit Cover Materials, Design, and Testing

The cover frames and lids shall be designed and manufactured by a qualified company having a minimum of five years successful experience in the production of similar airport apron slab fixtures. All cover lids and frames shall be designed using an appropriate cast aluminum alloy or rolled aluminum plate to support an aircraft wheel load simulated by a roving 200,000-pound test-load applied perpendicular to a 200-square-inch contact area (10 inches by 20 inches) of the cover's top surface. The aluminum alloy material selected for design shall be ductile, corrosion-resistant, impact-resistant, and suitable for the intended use. All covers shall be non-skid surface construction and free of injurious defects. Welding for the purpose of structural repair of casting defects shall not be allowed. Minor cosmetic welding is acceptable. The cover shall be capable of supporting the test-load without failure regardless of the location or orientation of the load. Localized yielding or cracking or excessive deformations shall be considered as failure. Actual load-tests shall be performed on a minimum of 10 percent of all the covers supplied. Load-tested units shall be randomly selected. Load-test conditions shall model field-installed conditions as nearly as practicable. The 200 Kip test-load shall be applied to the cover for a minimum duration of 5 minutes. Absolute maximum deflection of the cover lid under the test-load shall not exceed 1/180th of the interior diameter of the fiberglass pit body. Maximum deflection of the cover lids) remaining after removal of the test load shall be $\pm$ 0.010-inches to assure that no permanent set has taken place. Upon removal of the test-load, the cover lid and frame shall be carefully examined for cracks or localized areas of permanent deformation. All results shall be submitted for review and approval. A single failure to meet any of the stated criteria shall be considered sufficient grounds for the testing of 50 percent of the units. Provide test results for aircraft rated High Point Vent Frame and Cover and aircraft rated Low Point Drain Frame and Cover.

2.13.5 Pipe Riser Seal

The riser pipe penetration through the pit floor shall be sealed by means of a Buna-N boot. The boot shall be secured to a metal collar welded to the pipe riser and to a flange at the floor opening by stainless steel clamps. Collar shall be fabricated from the same material as the pipe.

2.13.6 Pit Equipment

Piping, fittings, valves and couplers shall comply with Section 15060 PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM.

2.14 OPERATING TANK LEVEL SWITCHES

System shall be designed and installed in such a way that the system shall be continuously and automatically self-checking without manual check. Electronic level sensors shall be thermistors or optic type, and be intrinsically safe Class I, Division 1, Group D for hazardous environments, with recognized FM,CSA or UL approval. Both high electronic level sensors shall be contained in a single multi-sensor holder/junction box. The sensor holder/junction box shall be accessible from the tank top or stairway.

2.14.1 Electronic Level Alarms

Level alarms shall be mechanically and electrically independent and be totally isolated from the gauging system. Two electronic high level alarms and one low level alarm shall be provided for each tank. A High Level Alarm (HLA) shall be set at approximately 90 percent of the safe tank filling height and be arranged to actuate an audible alarm signal located where shown on the drawings and an indicator light at the control panel. A High High Level Alarm (HHLA) shall be set at approximately 95 percent of the safe filling height. HHLA shall actuate an audible and visual alarm where shown on the drawing and an indicator light at the control panel. A Low Level Alarm (LLA) shall be set at 4'-0" (1220) above bottom of tank shell. When the LLA is activated, the associated tank's GDP low level light shall light. If the outlet valve is not fully closed, the alarm annunciator's critical alarm sequence activates, fueling pumps running in automatic mode shall be disabled and no pump shall be allowed to start automatically. If all tanks are at low level, no fueling pumps shall start automatically. Alarms shall be annunciated at Pump Control Panel

2.15 WATER DRAW-OFF SYSTEM

A water draw-off system shall be provided for each Operating Tank. Water draw-off system shall gravity drain. Each system shall include tank, water draw-off pump, start/stop switch, disconnect switch, motor starter, and all necessary pipe, valves, and fittings.

2.15.1 Tank

Water draw-off tank shall be a 55-gallon fabricated stainless steel tank with supporting legs as shown. Tank and support legs shall be fabricated from Type 304 stainless steel.

2.15.2 Sight Glass

Sight glasses for tank shall be standard tubular gages with density ball and shut-off valves on each end. Wetter parts other than sight glass shall be stainless steel. If glass breakage should occur, a stainless steel ball in the valve shall close preventing product loss. Glass shall be protected by minimum of four guard rods.

2.15.3 Water Draw-Off Pump

Water Draw-off pump (WDP-3 and WDP-4) shall have the capacity of not less than 10 gpm against a total head of 55 feet when driven at 1800 rpm. The pump shall have flange connections and shall be constructed of stainless steel or aluminum so as to have no zinc, brass or other copper bearing alloys in contact with the fuel. The unit shall be explosion-proof, Class I, Division 1, Group D with maximum temperature rating of ("T2D" -419 degrees F). The motor shall not be overloading at any point on the pump curve. Contractor has the option of selecting either centrifugal or positive displacement type pump with the restriction of the positive displacement type pump shall include a pressure relief between the discharge and suction protecting the pump from overloading.

2.15.4 Anchoring

All units of the water draw-off system shall be installed plumb and level and secured in place by anchor bolts.

2.16 UNLOADING LEVEL SWITCHES

a. Level control switches on unloading standpipe as indicated.

b. Wide differential with stainless steel displacers.

c. Heavy-duty mercury contacts rated 5 amps at 120Vac.

d. NEMA 7/9 enclosure for Class 1 hazardous location.

e. Adjustable settings for low, high and high high pump control levels.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Installation

Install equipment and components in position, true to line, level and plumb, and measured from established benchmarks or reference points. Follow manufacturer's recommended practices for equipment installation. Provide required clearances between equipment components. Equipment, apparatus, and accessories requiring normal servicing or maintenance to be accessible.

3.1.2 Anchoring

Anchor equipment in place. Check alignment of anchor bolts before installing equipment and clean-out associated sleeves. Do not cut bolts because of misalignment. Notify Contracting Officer of errors and obtain the Contracting Officer's acceptance before proceeding with corrections. Cut anchor bolts of excess length to the appropriate length without damage to threads. Where anchor bolts or like devices have not been installed, provide appropriate self-drilling type anchors for construction condition.

3.1.3 Grouting

Equipment which is anchored to a pad to be grouted in place. Before setting equipment in place and before placing grout, clean surfaces to be in contact with grout, including fasteners and sleeves. Remove standing water, debris, oil, rust, and coatings which impair bond. Clean contaminated concrete by grinding. Clean metal surfaces of mill scale and rust by hand or power tool methods. Provide necessary formwork for placing and retaining grout. Grout to be non-metallic, non-shrink, fluid precision grout of a hydraulic cementitious system with graded and processed silica aggregate, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents; free of aluminum powder agents, oxidizing agents and

inorganic accelerators, including chlorides; proportioned, pre-mixed and packaged at factory with only the addition of water required at the project site. Grouting shall be in accordance with ASTM C 827. Perform all grouting in accordance with equipment manufacturer's and grout manufacturer's published specifications and recommendations.

3.1.4 Leveling and Aligning

Level and align equipment in accordance with respective manufacturer's published data. Do not use anchor bolt, jack-nuts or wedges to support, level or align equipment. Install only flat shims for leveling equipment. Place shims to fully support equipment. Wedging is not permitted. Shims to be fabricated flat carbon steel units of surface configuration and area not less than equipment bearing surface. Shims to provide for full equipment support. Shim to have smooth surfaces and edges, free from burrs and slivers. Flame or electrode cut edges not acceptable.

3.1.5 Direct Drives

Alignment procedure follows:

3.1.5.1 Rotation Direction and Speed

Check and correct drive shaft rotation direction and speed.

3.1.5.2 End Play

Run drive shafts at operational speed. Determine whether axial end play exists. Run drive shaft at operational speed and mark drive shaft axial position when end play exists. Block drive shaft in operating position when aligning drive shaft with driven shaft.

3.1.5.3 Shaft Leveling and Radial Alignment

Check shaft leveling by placing a spirit level across the half faces. Radially align shafts by placing a straightedge across the two coupling half faces in both horizontal and vertical planes.

3.1.5.4 Angular Alignment and End Clearance

Check angular alignment and end clearance by inserting a feeler gage at 4 points, 90 degrees apart around outer edges of coupling halves.

3.1.5.5 Final Recheck

Check adjustments with dial indicator after completing recheck. Align shafts within 0.001 inch tolerance, except as other-wise required by more stringent requirements of equipment manufacturer.

3.2 INSTALLATION OF UNDERGROUND TANKS

Installation shall be per tank manufacturer's recommendations, API RP 1615, NFPA 30, EPA 40 CFR Part 280, state and local codes and as specified herein. If recommendations require tank to be filled, only fuel will be

allowed in tanks. Water filling is not acceptable. Before being placed in service, tank shall be tightness tested in accordance with NFPA 30.

3.2.1 Coating

The coating shall be examined for flaws and tested for thickness. The Contractor shall provide the facilities, personnel, and equipment for testing for flaws and thickness. Thickness shall be measured electronically. Coating shall be tested directly before placement of the tank with an electric flaw detector, equipped with a bell, buzzer, or other type of audible signal that operates when a flaw is detected. The detector for the type of coating used shall have an operating voltage of 10,000 to 35,000 volts. Check of the holiday detector potential may be made by the Contracting Officer at any time to determine the suitability of the detector. Damaged areas shall be repaired with materials identical to those used originally, and after drying, shall be retested electrically.

3.2.2 Steel Tanks

a. Cover the concrete hold down slab with 12 inches of tank bedding backfill evenly graded and thoroughly compacted, prior to tank placement.

b. Each tank is to be unloaded and placed on the sand bed using cranes and the rigging procedures provided by the tank manufacturer. Use the tank lifting lugs for lifting the tank into place. The use of slings around the tank is not permitted, nor is the use of chock blocks of any sort. During handling, carefully inspect the tanks for coating damage and repair any damage whatsoever before proceeding. After placement, check each tank to ensure it is sloped as required. The elevation shall be confirmed.

c. Before proceeding with backfill, install the hold down straps and tighten the turnbuckles securely and evenly throughout the length of the tanks. The bottom and sides of the tanks to be fully and evenly supported by hand shoveling and tamping. Use tank bedding backfill up to 12 inches above the top of tank. Hand-guided power equipment can be used to place fill in 6-inch layers, compacted to a minimum of 95 percent maximum density, after the bottom quadrant is filled. A minimum of four density tests per tank to be performed. Clean, noncorrosive, well tamped gravel to be used for backfill from a point 12 inches above the tanks to finished grade.

d. Do not fill the tank, even partially, before the bottom quadrant is backfilled. The level of fuel product not to exceed the level of compacted backfill at any time.

e. Coordinate tank installation with the installation of cathodic protection.

3.3 INSTALLATION OF FIBERGLASS PITS

The Contractor shall submit recommended installation procedures and setting tolerances from the pit manufacturer/supplier for the fiberglass pit and the aluminum cover. These procedures shall indicate recommended methods of supporting the pit in its proper position in the open excavation prior to and during concrete placement operations. Also, required installation tolerances, especially for flatness/levelness of the fiberglass pit lip, shall be provided. The Contractor shall follow these recommendations and shall apply other procedures as required to ensure the integrity of the pit liner and cover assemblies in their installed positions. All penetrations through the fiberglass pit liner shall be tightly sealed by suitable means to preclude water infiltration, with consideration for potential relative movements between the penetrating objects and the pit liner. Reference the Contract drawings for additional installation requirements.

3.4 POSTED OPERATING INSTRUCTIONS

For each designated system or equipment item, provide instructions for guidance of operating and maintenance personnel. Following approval of content, prepare these instructions in a form and scale that will be readily legible when displayed in appropriate locations, to be designated by the Contracting Officer and meet the following requirements:

3.4.1 Each System

For each system, include diagrams of equipment, piping, wiring and control. Define control sequences.

3.4.2 Each Tank

For each tank provide certified tank calibration chart in 1/8-inch increments reading in gallons.

3.4.3 Each Item

For each equipment item, include starting, adjustment, operation, lubrication, safety precautions and shut-down procedures. Identify procedures to be performed in event of equipment failure. Provide other instructions recommended by the manufacturer.

3.4.4 Diagrams

The Contractor shall provide a professionally prepared isometric piping diagram of the fueling system apparatus. Diagram shall be 36 inches x 54 inches and shall be color coded to match PCP color diagrams. Diagram shall show the entire facility and shall include all equipment and the operational sequences of all equipment with equipment numbers displayed. Diagram shall show all valves along with the valve numbers shown on the drawings and listed as normally open/closed. It shall be wall mounted under glass.

3.4.5 Volume of Fuel

The Contractor shall provide a certified system inventory of fuel in the pipe, tank, pumphouse, etc. The piping will show length of pipe, size of pipe, gallons per foot, and total gallons. Verify during initial fill.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15060

PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM

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SECTION 15060

PIPE, MANUAL VALVES, AND FITTINGS, FUELING SYSTEM

PART 1 GENERAL

1.1 REFERENCES

Waiver to Use MilStds and MilSpecs in Air Force Fuel Projects, HQ AFCESA/CESM (01/29/96).

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z49.1	(1988) Safety in Welding and Cutting

AMERICAN PETROLEUM INSTITUTE (API)

API SPEC 5L	(1995) Line Pipe
API SPEC 6D	(1994) Pipeline Valves (Gate, Plug, Ball, and Check Valves)
API STD 526	(1969) Flanged Steel Safety Relief Valves for use in Petroleum Refineries
API STD 594	(1991) Wafer and Wafer-lug Check Valves
API STD 607	(1993) Fire Test for Soft-Seated Quarter-Turn Valves
API STD 608	(1995) Ball Valves
API Bull 1529	(1998) Aviation Fueling Hose
API 1584	(2001) Four-inch Hydrant System Components and Arrangements
API RP 1110	(1991) Pressure Testing of Liquid Petroleum Pipeline

ASME INTERNATIONAL (ASME)

ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws Inch Series
ASME B18.2.2	(1987) Square and Hex Nuts (Inch Series)
ASME B31.1	(1995) Power Piping
ASME B31.3	(1999) Process Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1992) Structural Steel
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 105	(1996) Forgings, Carbon Steel, for Piping Components
ASTM A 106	(1999el) Seamless Carbon Seel Pipe for High-Temperature Service
ASTM A 181	(1995b) Carbon Steel Forgings, for General Purpose Piping
ASTM A 182	(1996e) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193	(1996b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	(1996) Carbon and Alloy Steel Nuts for

	Bolts for High-Pressure and High-Temperature Service
ASTM A 234	(1996a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 269	(1996) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312	(1991c) Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A 358	(1995) Electric-Fission-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
ASTM A 403	(1996) Wrought Austenitic Stainless Steel Piping Fittings
ASTM D 229	(1991) Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM E 94	(1991) Radiographic Testing
ASTM F 436	(1991) Hardened Steel Washers

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1989) Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying and Thermal Cutting
AWS A5.1	(1991) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.4	(1981) Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes
AWS A5.5	(1981) Low-Alloy Steel Covered Arc Welding Electrodes

FEDERAL SPECIFICATIONS (FS)

FS L-C-530	**(Rev C) Coating, Pipe, Thermoplastic Resin**
FS L-T-1512	(Rev A; Reinst) Tape, Pressure Sensitive Adhesive, Pipe Wrapping

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1988) Pipe Hangers and Supports-Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports-Selection and Application

MILITARY SPECIFICATIONS (MS)

MS MIL-N-5877	(Rev E) Nozzle, Pressure Fuel Servicing, Locking, Type D-1, D-2, D-2R Nominal 2-1/2 inch diameter
MIL-R-6855	(Rev. E; Supp. 1) Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes
MS MIL-S-13789	(Rev D) Strainers, Sediment: Pipeline, Basket Type

MILITARY STANDARDS (MIL-STD)

MIL-STD-161	(Rev F; Notice 2) Bulk Petroleum Products System Including Hydrocarbon Missile Fuels
MIL-STD-271	(Rev F) Nondestructive Testing Methods
MIL-STD-24484	(Rev J) Adapter, Pressure Fuel Servicing, Nominal 2.5 inch diameter

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1990) Flammable and Combustible Liquids Code

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 514	(1989) Hydraulic Tube Fittings, Standard

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping; G

Fittings; G

Ball Valves; G

Plug Valves; G

Check Valves; G

Relief Valves; G

Surge Absorber; G

Sight Flow Indicators; G

Strainers; G

Isolating Gasket Kits; G

Gaskets; G

Lightning Surge Arrester; G

Exterior Protective Pipe Coatings; G

Pipe Wrap; G

Sample Connections; G

Flanged Swivel Joints; G

Fuel Hose; G

Pressure Fueling Nozzle; G

Nozzle Adapter (SPR); G

Pig Launcher and Receiver; G

Flexible Hoses; G

Valve Tags; G

Automatic Air Eliminator; G

Pressure Sensitive Labels; G

Instrument Valves; G

Unloading Dry Break Coupler; ; G

Quick Coupling; G

SD-06 Test Reports

Holiday Test

Pneumatic Test; G

Hydrostatic Pressure Test; G

SD-07 Certificates

Qualifications of Welders; G

Certificate of Pipe Coating Applicator Experience

Piping; G

Fittings; G

Pipe/Fitting Inspector; G

Pipe Weld Radiograph Inspector's Certification; G (for field welds)

Isolating Gasket Kits; G

Survey of final elevation of buried fuel pipe; G

Survey giving elevation at each joint, elbow, and tee.

SD-10 Operation and Maintenance Data

Operation and maintenance information shall be submitted for the equipment items or systems listed below. Refer to Section 01730 FACILITY OPERATION AND MAINTENANCE MANUAL for the information to be submitted for various type of equipment and systems.

Ball Valves
Strainer
Sample Connections
Isolating Gasket Kits
Gaskets
Flexible Hoses
Plug Valves
Check Valves
Surge Absorber
Sight Flow Indicators
Flanged Swivel Joints
Nozzle Adapter
Pig Launcher and Receiver
Lightning Surge Arrester
Automatic Air Eliminator
Instrument Valves
Unloading Dry Break Coupler
Quick Coupling

PART 2 PRODUCTS

2.1 DESIGN CONDITIONS

Design conditions shall be as specified in Section 15050 MECHANICAL EQUIPMENT, FUELING SYSTEM.

2.2 MATERIALS

2.2.1 General

Pipe and fittings in contact with fuel shall be stainless steel or, carbon steel as indicated on the drawings. No zinc coated metals, brass, bronze or other copper bearing alloys shall be used in contact with the fuel. All carbon steel and stainless steel underground piping shall have a protective coating and shall be cathodically protected in accordance with Section 13112 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT). Identification of piping shall be in accordance with MIL-STD-161 unless specified otherwise. Material for manual valves shall be as specified hereinafter.

2.2.2 Carbon Steel Piping

Each length of pipe shall be subjected to factory hydrostatic testing and ultrasonic testing in accordance with their respective pipe specification.

a. Piping 12-Inches and Larger: Seamless, ASTM A 53 Grade B having a wall thickness of 0.375-inch.

b. Piping 2 1/2-Inches through 10-Inches: Seamless, Schedule 40 API SPEC 5L Grade B or ASTM A 53 Grade B.

c. Piping Two-Inches and Smaller: Seamless, Schedule 80 API SPEC 5L Grade B or ASTM A 53 Grade B.

d. Welding Electrodes: E70XX low hydrogen electrodes conforming to AWS A5.1 or AWS A5.5.

2.2.3 Stainless Steel Piping

a. Piping 2 1/2-Inches and Larger:

(1) ASTM A 358, Grade 304L, Class 1 or Class 3 with supplementary requirements of S1, S2 and S3, or ASTM A 312 Type 304L, seamless (only). Any agreements between the purchaser and the manufacturer or supplier as referenced in the applicable ASTM shall include the Contracting Officer as a party to the agreement. All piping welds will receive 100 percent radiographic inspection, 100 percent liquid penetrant inspection, 100 percent visual inspection and all tests as required by the applicable ASTM Standard. Piping shall be provided with a nominal wall thickness as shown in Table A for ASTM A 358 with the deviation from the nominal wall thickness less than 0.01-inch. ASTM A 312 seamless piping shall be

provided with a minimum schedule 10S wall thickness.

(2) Pipe Ends: All Piping shall be provided with beveled ends per Chapter V, ASME B31.3, and shall be shipped with the ends capped.

(3) Seam and End Welds: All sections of the piping provided shall be accepted on the project site if the seam welds meet the requirements of the paragraph K341 of ASME B31.3 and Appendix 4 of ASME BPV VIII Div 1. One hundred spots may be reinspected at the project site prior to installation and backfilling at the request of the Contracting Officers Representative. End welds shall be properly aligned prior to welding per Chapter V of the ASME B31.3. Welds found to be defective shall be repaired as per Chapter V of the ASME B31.3 at no additional cost to the government. Observation by the Contracting Officers Representatives of the manufacturing and field procedures shall be allowed under this contract.

(4) Welders Qualifications: Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

(5) Factory Testing and Inspection Records: Per Table K341.3.2A of Chapter VII of ASME B31.3, visual, radiographic and liquid penetrant tests shall be performed for each section of piping provided as all sections are subjected to cyclic conditions. All testing and inspections records shall be submitted to the Contracting Officers Representative and shall indicate the pipe mark and installed location of what piping section on the project site. Observation by the Contracting Officers Representatives of the manufacturers and the fields testing and inspection procedures shall be allowed under this contract. Contractor shall notify the Contracting Officer 90 days in advance when the piping for this contract will be manufactured. Pipe certification along with pipe markings shall be submitted before the pipe arrives on the job site.

(6) Welding Inspectors for Stainless Steel Piping: The contractor shall submit the qualifications of all the testing personnel that will perform all field tests as requested by the Contracting Officer. The qualifications of all personnel on the job site that will perform welding inspection shall be submitted for approval. These inspectors shall meet the qualifications as defined in Chapter VI of the ASME B31.3, and may use the methods as defined in Table K341.3.2 B of the ASME B31.3. Provide a Pipe Weld Radiograph Inspector's Certification for each inspector.

(7) The Contractor shall provide a qualified pipe/fitting inspector in

accordance with Chapter VI of ASME B31.3. to act as the owner's inspector (for the Government) at the pipe manufacturer's facility in addition to the manufacturer's inspector.

(8) Quality Assurance Plan shall be submitted for the welding, inspecting and testing of the welded seam pipe. All underground piping welds shall be 100% radiographed.

TABLE A

Nominal Pipe Size	Nominal (Average) Pipe O.D.	Wall Thickness(tn)
16 in.	16.000 in.	0.312 in.
14 in.	14.000 in.	0.312 in.
12 in.	12.750 in.	0.250 in.
10 in.	10.750 in.	0.250 in.
8 in.	8.625 in.	0.250 in.
6 in.	6.625 in.	0.219 in.
4 in.	4.500 in.	0.219 in.
2 1/2 in.	2.875 in.	0.156 in.

b. Piping Two-Inches and Smaller: Schedule 80 ASTM A 312 seamless Type 304L for threaded piping and schedule 40 (unless otherwise indicated) ASTM A 312 seamless Type 304L for welded piping.

c. Stainless Steel Control Tubing: Seamless, fully annealed tubing conforming to ASTM A 269, Grade TP316, Rockwell hardness B80 or less. Wall thickness for 1/2-inch tubing to be 0.049-inch.

d. Welding Electrodes: E308L conforming to AWS A5.4.

2.2.4 Protective Coatings for Aboveground Carbon Steel Piping

Provide coating of aboveground piping, piping in pits, pipe supports, filter separators, and miscellaneous metal and equipment in accordance with Section 09971 EXTERIOR COATING OF STEEL STRUCTURES.

2.2.5 Exterior Protective Pipe Coatings for Buried Steel Piping

Provide pipe with FS L-C-530 coating system of factory-applied adhesive undercoat and continuously extruded plastic resin coating; minimum thickness of plastic resin shall be 36 mils for pipe sizes 6 inches and larger. Pipe coating system, tape coat systems and coating repair systems shall be able to withstand the harmful effects of continuous submersion in brackish salt water, abrasion by coral fill and exposure to fuel. Fittings, couplings, irregular surfaces, damaged areas of pipe coating, and existing piping affected by the Contractor's operations shall be clean, dry, grease free, and primed before application of tape. Tape shall overlap the pipe coating not less than 3 inches. Waterproof shrink sleeves may be provided in lieu of tape and shall overlap the pipe coating not less than 6 inches. Pipe coating and adhesive undercoat surfaces to be wrapped

with tape shall be primed with a compatible primer prior to application of tape. Primer shall be as recommended by tape manufacturer and approved by the pipe coating manufacturer.

2.2.5.1 Pipe Wrap

Fittings, couplings, irregular surfaces, damaged areas of pipe coating, and existing piping affected by the Contractor's operations shall be clean, dry, grease free, and primed before application of tape. Tape shall overlap the pipe coating not less than three inches. Waterproof shrink sleeves may be provided in lieu of tape and shall overlap the pipe coating not less than six inches. Pipe coating and adhesive undercoat surfaces to be wrapped with tape shall be primed with a compatible primer prior to application of tape. Primer shall be as recommended by tape manufacturer and approved by pipe coating manufacturer.

a. Damaged Areas of Pipe Coating: Provide FS L-T-1512, 20 mils nominal thickness of tape over damaged areas. Residual material from damaged areas of pipe coating shall be pressed into the break or trimmed off. Apply tape spirally with one-third overlap as tape is applied. A double wrap of one full width of tape shall be applied at right angles to the axis to seal each end of the spiral wrapping.

b. Fittings, Couplings, and Regular Surfaces: Provide FS L-T-1512, 10 mils nominal thickness tape overlapped not less than 1.0 inch over damaged areas. Initially stretch and apply first layer of tape to conform to component's surface. Then apply and press a second layer of tape over first layer of tape.

2.2.5.2 Testing of Protective Coatings

Perform tests with an approved silicone rubber electric wire brush or an approved electric spring coil flaw tester. Tester shall be equipped with an operating bell, buzzer, or other audible signal which will sound when a holiday is detected at minimum testing voltage equal to 1,000 times the square root of the average coating thickness in mils. Tester shall be a type so fixed that field adjustment cannot be made. Calibration by tester manufacturer shall be required at six-month intervals or at such time as crest voltage is questionable. Certify in writing the calibration date and crest voltage setting. Maintain the battery at ample charge to produce the crest voltage during tests. Areas where arcing occurs shall be repaired by using material identical to original coating or coating used for field joints. After installation, retest the exterior surfaces, including field joints, for holidays. Promptly repair holidays. Provide Holiday Test report.

2.2.6 Fittings

2.2.6.1 General

Welding ells, caps, tees, reducers, etc., to be of materials compatible for welding to the pipe line in which they are installed, and wall thickness,

pressure and temperature ratings of the fittings shall be not less than the adjoining pipe line. Unless otherwise required by the conditions of installation, all elbows shall be the long radius type. Miter joints shall not be acceptable. Make odd angle offsets with pipe bends or elbows cut to the proper angle. Butt weld fittings to be factory-made wrought fittings manufactured by forging or shaping. Fabricated fittings shall not be permitted. Welding branch fittings shall be insert type suitable for radiographic inspections specified herein.

2.2.6.2 Carbon Steel Fittings

a. Fittings 2-1/2 Inches and Larger: Butt weld, conforming to ASTM A 234, grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. All welds shall be radiographically examined throughout the entire length of each weld. Each fitting shall be subjected to the Supplementary Requirements S3 and S4, Liquid Penetration examination and Magnetis-Particle Examination. Detectable flaws shall not be accepted in the supplementary examinations. Fittings shall be identified to relate them to their respective radiograph.

b. Fittings 2 Inches and Smaller: Forged (socket welded or if indicated on drawings, threaded), 2,000-pound W.O.G., conforming to ASTM A 105, Grade 2 and ASME B16.11. Threaded fittings shall only be used for above grade applications. Underground low point drain pipe and high point vent pipe shall be butt welded.

c. Flanges: One-hundred-fifty-pound weld neck, forged flanges conforming to ASTM A 181, Grade 2, and ASME B16.5. Flanges to be 1/16-inch raised face with phonographic finish, except where required otherwise to match equipment furnished. Match flange face to valves or equipment furnished. Flange face shall be machined to match valves or equipment furnished. Use of spacing rings or gaskets discs are not allowed. Flanges shall be subjected to the Supplementary Requirements S4 and S5, Liquid Penetrant Examination, and Magnetic-Particle Examination. Detectable flaws shall not be accepted.

2.2.6.3 Stainless Steel Fittings

a. Fittings 2-1/2 Inches and Larger: Butt weld stainless steel conforming to ASTM A 403, Class WP, Type 304L, seamless or welded, and ASME B16.9 of the same minimum wall thickness as the adjoining pipe. Welded fittings shall be tested and inspected the same as the welded seam pipe and meet the same requirements as for the pipe.

b. Fittings 2-Inches and Smaller: Forged Type 304 or 304L (socket welded or if indicated on drawings, threaded), 2,000-pound W.O.G. conforming to ASTM A 182 and ASME B16.11. Threaded fittings shall only be used for above grade applications. Underground low point drain pipe and high point vent pipe shall be butt welded.

c. Unions: Conforming to ASTM A 312, Grade 304 or 316.

d. Flanges: One-hundred-fifty-pound weld neck, forged Type 304 or 304L stainless steel flanges conforming to ASTM A 182 and ASME B16.5, except flanges that are to be connected to the fueling/defueling pumps shall be 300-pound. Flanges to be 1/16-inch raised-face with phonographic finish, except where required otherwise to match equipment furnished. Match flange face to valves or equipment furnished. Flanges shall be subjected to the Supplementary Requirements S4, Liquid Penetrant Examination.

e. Stainless Steel Tube Fittings: Flareless, 316 stainless steel fittings conforming to SAE J 514.

2.2.6.4 Isolating Gasket Kits (Insulating) for Flanges

Provide ASTM D 229 electrical insulating material of 1,000 ohms minimum resistance; material shall be resistant to the effects of aviation hydrocarbon fuels. Provide full face insulating gaskets between flanges. Provide full surface 0.03-inch thick wall thickness, spiral-wound mylar insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 0.125-inch thick high-strength phenolic insulating washers next to flanges and provide flat circular stainless steel washers over insulating washers and under bolt heads and nuts. Provide bolts 0.5-inch longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts. Exterior above grade flanges separated by electrically isolating gasket kits shall be provided with weatherproof lightning surge arrester devices. The surge arrester shall bolt across flanges separated by insulating gasket kits per detail on contract drawings. The arrestor shall have the following features:

a. Weatherproof NEMA 4 enclosure.
b. Bidirectional and bipolar protection.
c. Constructed of solid state components, no lights, fuses or relays shall be used that will require maintenance or replacement.
d. Withstand unlimited number of surges at 50,000 Amperes.
e. Maximum clamping voltage of 700 Volts based on a IEEE C62.41 8x20 microsecond wave form at 50,000 Amperes peak measured at the device terminals (zero lead length).
f. A UL listed arrester for installation in Class 1, Division 2, Group D, hazardous areas.

Install the mounting bracket and leads on the flange side of the bolt insulating sleeve and washer, and size in accordance with this schedule.

Line Size (Inches)	Bolt Size (Inches)
2	5/8

2-1/2	5/8
3	5/8
4	5/8
6	3/4
8	3/4
10	7/8
12	7/8
14	1
16	1

(Note: Allowance must be made for the 1/32-inch thickness of the insulating sleeve around the bolts when sizing the mounting lugs.)

2.2.7 Bolts and Nuts

Bolts and nuts for pipe flanges, flanged fittings, valves and accessories shall conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project no more than two full threads beyond the nuts with the bolts tightened to the required torque. Bolts shall be regular hexagonal bolts conforming to ASME B18.2.1 with material conforming to ASTM A 193, Grade B7. Bolts shall be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes one inch and smaller and Eight-Pitch Thread Series for sizes larger than one inch. Nuts shall conform to ASME B18.2.2, hexagonal, heavy series with material conforming to ASTM A 194, Grade 8. Nuts shall be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes one inch and smaller and Eight-Pitch Thread Series for sizes larger than one inch. Provide washers under bolt heads and nuts. Washers to be ASTM F 436, flat circular stainless steel. Torque wrenches shall be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern shall be as recommended by the gasket manufacturer. Anti-seize compound shall be used on stainless steel bolts.

2.2.8 Gaskets

ASME B16.21, composition ring, using a Buna-N binder, 0.1250-inch thick. Gaskets shall be resistant to the effects of aviation hydrocarbon fuels and manufactured of fire-resistant materials. Full-face gaskets shall be used for flat-face flanged joints. Ring gaskets shall be used for raised-face flanged joints. Gaskets shall be of one piece factory cut.

2.2.9 Field Applied Protective Coatings

The field joints and fittings of all underground piping shall be coated as herein specified.

2.2.9.1 Welded Joints

Heat shrinkable radiation-cross-linked polyolefin wraparound type sleeves shall be applied to all welded joints. Joints shall not be coated until pressure testing is complete. Apply sleeves consisting of 40 mil polyolefin backing and 40 mil thermoplastic mastic adhesive in accordance with the manufacturer's instructions.

2.2.9.2 Fittings

Fittings and other irregular surfaces shall be tape wrapped. The tape shall be a plastic mastic laminated tape having 6 mil plastic backing of either polyethylene or polyvinylchlorine and 29 to 44 mil of synthetic elastomer.

2.2.10 Threaded Joints

Threaded joints, if indicated on the drawings, shall be made tight with manufacturer recommended teflon tape or a mixture of graphite and oil, inert filler and oil, or with a graphite compound, applied with a brush to the male threads. Not more than three threads shall show on made up joints. Threaded joints, mechanical couplings and flanges will not be permitted in buried piping. Threaded joints shall not get welded.

2.2.11 Welded Joints

Welded joints in steel pipe shall be as specified in Part 3 "EXECUTION."

2.3 MANUAL VALVES

All portions of a valve coming in contact with fuel in stainless steel pipe lines shall be of noncorrosive material. Valves in stainless steel pipe lines shall be Type 304 or Type 316 stainless steel or carbon steel internally plated with chromium or nickel or internally electroless nickel plated. Stem and trim shall be stainless steel for all valves. Manually operated valves six inches and larger shall be worm-gear operated and valves smaller than six inches shall be wrench operated. Valves smaller than two inches shall have lever-type handles. Valves installed more than eight (8) feet above finished floor shall have chain operators and a position indicators visible from ground level. Sprocket wheel for chain operator shall be aluminum.

2.3.1 Ball Valves

Ball valves shall be fire tested and qualified in accordance with the requirements of API STD 607 and API STD 608. Ball valves shall be nonlubricated valves that operate from fully open to fully closed with 90 degree rotation of the ball. Valves two inches and larger shall conform to applicable construction and dimension requirements of API SPEC 6D, ANSI Class 150 and shall have flanged ends. Valves smaller than 2 inches shall be ANSI class 150 valves with one piece bodies with flanged ends, unless noted otherwise. The balls in valves 10 inches full port and 12 inch regular port and larger shall have trunnion type support bearings. Except as otherwise specified, full port valves shall be provided upstream and downstream of all control valves and where indicated. All ball valves downstream of thermal relief valves shall be furnished with locking devices and shall be locked open.

2.3.1.1 Materials

Ball shall be stainless steel. Ball valves shall have tetrafluoroethylene

(TFE) or Viton seats, body seals and stem seals. Valves 2 inches and smaller shall have a locking mechanism.

2.3.2 (Double Block and Bleed) Plug Valves

API SPEC 6D, Type III, ANSI Class 150, non-lubricated, resilient, double seated, trunnion mounted, tapered lift plug capable of two-way shutoff. Valve shall have stainless steel or carbon steel body with chrome-plated interior, tapered plug of steel or ductile iron with chrome or nickel plating and plug supported on upper and lower . Sealing slips shall be steel or ductile iron, with Viton seals which are held in place by dovetail connections. Valve design shall permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves shall have weatherproof operators with mechanical position indicators. Minimum bore size shall be not less than 65 percent of the internal cross sectional area of a pipe of the same nominal diameter unless bore height of plug equals the nominal pipe diameter and manufacturer can show equal or better flow characteristics of the reduced bore size design. Provide valves with full bore where indicated and as double block and bleed where indicated.

2.3.2.1 General

Valves in the operating tank suction lines shall be provided with a factory-installed limit switch that is actuated by the valve closure. Each switch shall have one double pole double throw contacts, and shall be watertight and U.L. listed for Class I, Division 1, Group D hazardous areas with (T2D-419 F) temperature limitation.

2.3.2.2 Valve Operation

Rotation of the handwheel toward open shall lift the plug without wiping the seals and retract the sealing slips so that during rotation of the plug clearance is maintained between the sealing slips and the valve body. Rotation of the handwheel toward closed shall lower the plug after the sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, the slips shall form a secondary fire-safe metal-to-metal seat on both sides of the resilient seal. Plug valves located in Isolation Valve Pits shall be provided with handwheel extensions through the platform.

2.3.2.3 Relief Valves

ANSI Class 150. Provide plug valves with automatic thermal relief valves to relieve the pressure build up in the internal body cavity when the plug valve is closed. Relief valves shall open at 25 psi differential pressure and shall discharge to the throat of, and to the upstream side, of the plug valve.

2.3.2.4 Bleed Valves

ANSI Class 150, stainless steel body valve. Provide manually operated bleed valves that can be opened to verify that the plug valves are not

leaking when in the closed position.

2.4 CHECK VALVES

Check valves shall be non-slamming, springloaded, dual plate wafer style suitable for 275 psi working pressure, designed and tested to API STD 594. Valve ends shall be suitable for installation between ANSI Class 150 with flanged end connections. Check valves shall have 316 SS plate, pins and springs and resilient viton seat. Valve body material shall match the piping system.

2.5 THERMAL RELIEF VALVES (TRV)

Relief valves shall be the fully enclosed, spring loaded, angle pattern, single port, hydraulically operated type with plain caps, and shall be labeled in accordance with ASME BPV VIII Div 1. Valve stems shall be fully guided between the closed and fully opened positions. The valves shall be factory-set to open at the set pressure indicated on the drawings. Operating pressure shall be adjustable by means of an enclosed adjusting screw. The valves shall have a minimum capacity of 20 GPM at 10 percent overpressure and shall operate at rated capacity with a back pressure not exceeding 50 psi. Valves shall have a replaceable seat.

2.5.1 Materials

Valve body material shall match the piping. Valve bonnets with stainless steel springs and trim. Seat material shall be compatible with JP-8. Valves shall be Class 150 flanged end connections.

2.6 SIGHT FLOW INDICATORS

Sight flow indicators shall be ANSI Class 150 and shall have flanged end connections. Sight flow indicators shall consist of a housing containing a rotating propeller that is visible through a glass observation port. The housing shall be stainless steel when installed in stainless steel lines and carbon steel when installed in carbon steel lines. The glass in the indicator shall also meet the Class 150 rating. The indicator down stream of the Pressure Control Valve (PCV) shall contain a bi-directional flapper instead of a propeller.

2.7 PIPING ACCESSORIES

2.7.1 Pipe Sleeves

Pipe sleeves shall be installed at all points where the piping passes through concrete construction. Such sleeves shall be of sufficient inside diameter to provide a minimum clear distance between the pipe and the sleeve of 1/2-inch. Sleeves through concrete pits or slabs shall be standard weight carbon steel pipe with a protective coating. Each sleeve shall extend through the respective pit wall or slab and shall be provided with a Buna-N sleeve boot seal. Use stainless steel band to secure the boot seal.

Alignment of the sleeve and piping shall be such that the pipe is

accurately centered within the sleeve by a nonconductive centering element (pipeline crossing insulators). The sleeve shall be securely anchored to prevent dislocation. Closure of space between the pipe and the pipe sleeve shall be by means of a mechanically adjustable segmented elastomeric seal (sleeve seal). The seal shall be installed so as to be flush.

2.7.2 Strainers

2.7.2.1 Basket Type

Strainer shall be in compliance with MS MIL-S-13789, except as specified otherwise. Strainer end connections shall be designed in accordance with ASME B16.5, Class 150. Strainers shall have stainless steel bodies, stainless steel shall be Types 304 or 316. Strainers shall have removable baskets of 60 mesh wire screen with larger wire mesh reinforcement; wire shall be stainless steel, Type 316. Pressure drop for clean strainer shall not exceed three psig at maximum design flow rate. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than three to one. Each strainer shall be provided with a suitable drain at the bottom, equipped with a ball valve. Strainer shall be the single inlet, single outlet design. Strainer shall be supplied with a piston type direct reading differential pressure gage as specified in SECTION 15880 FILTER SEPARATOR.

2.7.2.2 Cone Type (Temporary)

Strainer shall be stainless steel type 304 or 316, 60 mesh screen with the ratio of net open area of strainer to the area of the connecting pipe shall be not less than one to one.

2.7.3 Pipe Hangers and Supports

2.7.3.1 General

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69. Supports shall be provided at the indicated locations. Support channels for drain lines shall be epoxy coated on all surfaces or hot-dip galvanized after the channels are cut to length. Coated supports shall be coated with fusion bonded epoxy resin applied by the fluidized bed method. Thickness of the coating shall be not less than 10 mils. Surface preparation and coating application shall be in accordance with the epoxy manufacturer's instructions. The coating shall be pinhole free when tested with a low voltage holiday detector set at no more than 100 times the mil thickness of the coating. All pinholes shall be marked, repaired and retested to ensure a pinhole free film. The coating material shall be a 100 percent solids, thermosetting, fusion-bonded, dry powder epoxy resin. The manufacturer shall certify that the material is suitable for fluidized bed application and that it is approved by the Environmental Protection Administration.

2.7.3.2 Adjustable Pipe Supports

Adjustable pipe supports shall consist of a cast iron saddle and a threaded nipple connected to a carbon steel pipe by means of a special reducer conforming to MSS SP-69. The supports shall be provided with neoprene

insulation strips.

2.7.3.3 Low Friction Supports

Low friction supports shall be self-lubricating antifriction element composed of reinforced TFE. Units shall be factory designed and manufactured.

2.7.3.4 Concrete and Grout

Concrete and grout for anchors and supports shall comply with SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7.4 Sample Connections

Sample connections shall be factory assembled units specifically designed for obtaining representative samples from fuel pipelines. Each connection shall include a 1/4-inch sampling probe where the probe faces upstream, ball valve and 1/4-inch quick disconnect coupling (valved dry break) with dust plug, all assembled into a unit that is suitable for installation in a pipe nipple. The sampling probe shall extend not less than one inch into the fuel pipe. All materials in the sample connections shall be stainless steel or aluminum.

2.7.4.1 Sampling Hoses

Furnish two sampling hose assemblies to the Contracting Officer at the project site. Each assembly shall consist of a six-foot length of 1/4-inch clear plastic tubing with internal bonding/grounding wire. One end of the tubing will contain a male connector that actuates flow when inserted into the quick disconnect coupler. Each end of the bonding/grounding wire shall be equipped with clips for attaching to the pipe and metal sample container.

2.7.5 Flanged Swivel Joints

Flanged swivel joints shall be capable of rotating 360 degrees. Welded swivel joints and welding of swivel joints to the pipe and/or elbow is not permitted. Swivel joints shall be of the non-lubricated, maintenance free type with nonlubricated bearings and no lubricating fitting. Swivel joint shall be flanged at the end connecting to the piping system and threaded (female NPT) at the end connecting to the fuel hose. No leakage shall be permitted under positive or negative pressure conditions. No leakage shall be permitted under high or low temperature conditions. Welding of swivel joint to six-bolt flange connector is permitted. The swivel joints shall be warranted for two years against leakage. There must be electrical continuity from one flange to the other without the use of ground straps.

2.7.6 Monitoring Points

At the following locations, provide half-inch pipe, flanged ball valve, and blind flange for future test equipment connections:

a. At the Hydrant Hose Truck Checkout, inlet to Hydrant Valve.

b. At the inlet to the Back Pressure Control Valve in the Pumphouse.

c. At both sides of the isolation valve in all the isolation valve pits.

2.7.7 Fuel Hose

Fuel hose shall conform to API Bull 1529, Grade 2, Type C, threaded, male NPT, both ends.

2.7.8 Pressure Fueling Nozzle

Nozzles shall conform to MS MIL-N-5877, Type D-2. Nozzles and nozzle components shall be compatible with the fuel to be handled. Nozzles shall be provided with an internal 60 mesh stainless steel strainer and a fuel sample connection tapping. Nozzle design shall be for single point fueling of aircraft. Nozzles shall be provided with a compatible dry break quick disconnect swivel. Coupler shall allow for quick disconnect and reconnect of fueling nozzles with corresponding adapters. Coupler and adapter shall provide a positive, leak proof connection under constant or surge flow. Coupler shall be designed to prevent blowout of internal poppet.

2.7.9 Nozzle Adapter (SPR)

Adapter shall be a nominal 2-1/2 inches with self-closing valve in accordance with MIL-STD-24484. Adapter shall have a 4 inch flange mounting and metal sealing, vacuum tight, locking dust cap using the SPR (single point receptacle) lugs.

2.8 SURGE ABSORBER

Contained bladder style charged with nitrogen. Designed to have a net gas capacity of 80 gallons. Working fluid is jet fuel JP-8 with a specific gravity of 0.81$\pm$0.05. Carbon steel chamber to be rated at 275-psig working pressure in accordance with the ASME Pressure Vessel Code. Removable stainless steel top shall include charging valve and pressure gauge. Bladder to be Buna-N conforming to MIL-R-6855. Furnish (one) spare bladder. Connection shall be (4)-inch, (150)-pound ANSI raised face flange. The piping connection shall be provided with an energy dissipation device designed to provide unrestricted flow into the vessel and restricted flow from the vessel. Absorber shall be provided with charging and gauging assembly.

2.9 PIG LAUNCHER AND RECEIVER

2.9.1 General

Pig launcher and pig receiver assemblies shall be skid mounted, factory fabricated and factory tested units. The manufacturer shall have not less than 5 years' experience in manufacturing these assemblies. Each assembly shall be capable of launching and receiving pipeline cleaning type pigs. The launcher shall be designed to allow for convenient insertion of the

various "pigs" and propel the cleaning pig into the 14-inch diameter hydrant line. The receiver shall be designed to trap, hold and allow convenient removal of the cleaning "pigs," following isolation from the 14-inch diameter hydrant line. Dimensions, configuration and overall arrangement indicated on the drawings are minimum values. The assemblies and their components shall be catalog products of the manufacturer. Provide catalog data and shop drawings. The transfer system working pressure is 130 psi and 150 lb ANSI Class.

2.9.2 Construction

Assemblies shall be designed, fabricated, and hydrostatically tested in accordance with ASME BPV VIII Div 1. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX. Unacceptable welds shall be repaired, rewelded and reradiographed as required by the code. Provide results of the factory pressure testing of both assemblies.

2.9.2.1 Materials

Provide ASTM A 106 Grade B seamless, schedule 80 minimum wall thicknesses piping. Fittings shall be ASTM A 234 Grade WPB and match the piping. Flanges shall be Class 300 forged steel weld-neck conforming to ASME B16.5. For fittings 50 mm and smaller fittings shall conform to ASME B16.11 and ASTM A 105 Grade II. All flanges shall be raised face design and conform to ASME B16.5. Provide nonasbestos filler type 304 ss windings type gaskets. The skid material shall conform to ASTM A 36.

2.9.3 Skid Mounting

Each assembly shall be arranged on a structural steel skid constructed on main skid runners and at least four wide flange cross members. The piping shall be mounted on steel saddles, which cover 120 degrees of the pipe and supported on welded steel legs. Furnish a minimum of two steel saddles per pipe. Saddles, support legs and skid shall be all welded construction and fabricated from rolled shapes and plates conforming to ASTM A 36. Provide lifting lugs at each end of the assemblies suitable for balanced lift.

2.9.4 Coating

Each assembly shall be a factory prepared and coating applied according to Section 09971, EXTERIOR COATING SYSTEM OF STEEL STRUCTURES. The finish color shall be as indicated.

2.9.5 Accessories

Provide each assembly with the following:

a. Four-inch fuel bypass connection.

b. One-inch ball valve vent connection at the high point of the assembly with plug and visual flow detection.

c. Two-inch ball valve drain connection at the low point of the

assembly.

d. Full bore plug valves in size as indicated on the drawings. Valves shall be as specified within this Section.

e. Valves shall be certified "fire safe" per API STD 607 and shall be rated for ANSI Pressure Class as indicated for adjoining piping.

f. Hinged quick opening closure, which opens on the horizontal axis shall be provided at the end of both the launcher and receiver assemblies. Design of the closure shall permit convenient removal of the cleaning "pig." The closure shall incorporate two intrinsically safe bleeder locks, which ensure that any residual pressure is released before the closure is opened. Closure sealing mechanism shall be designed such that as the assembly's pressure increases the sealing action also becomes more efficient. Nonmetallic sealing elements shall be designed for use with JP-8.

g. Provide a pig signaler, which gives a visual indication that the "pig" has passed the signaler location. Pig signaler shall be the manufacturer's standard catalog item. Provide a flanged connection.

h. Thermal relief valves shall comply with API STD 526. Relief valves shall have steel bodies. All other wetted metal parts shall be stainless steel. Seat material shall be compatible for JP-8. Relief valves and appurtenances shall be as required by ASME Code.

i. Pressure gauge and instrument valve assembly shall be as specified in Section 15050, "Mechanical Equipment, Fueling."

2.10 FLEXIBLE HOSES

Flexible hoses for fueling pumps shall have ANSI Class 300 flanges of stainless steel construction conforming to ASME B16.5. Flexible hoses shall be of stainless steel flexible metal hose consisting of an inner corrugated stainless steel tube with stainless steel braid cover. All components to be suitable for not less than 275 psig. Length and application of flexible hoses shall be per manufacturer's written recommendations. Provide control rods for flexible hoses mounted on the pump discharges.

2.11 VALVE TAGS

Provide a 1-3/8-inch diameter, 3/16-inch thick brass tag. Stamp or engrave the valve number using 1/4-inch high letters and numbers, as indicated on the drawings and as directed by the Contracting Officer. Using a brass chain and S-hook, secure the valve tag to the valve.

2.12 AUTOMATIC AIR ELIMINATOR

Air eliminator shall be 1 inch with stainless steel body and cover, stainless steel float, and Buna-N seat. All wettable surfaces shall be

compatible with JP-8. Air eliminator stainless steel ball check valve with viton seals shall be installed above air eliminator. A manual air vent shall be provided between the air eliminator and the pipe. The air eliminator shall release at pressures up to 150 psi with no fuel leakage.

2.13 PRESSURE SENSITIVE LABELS

Identification of piping shall be in accordance with MIL-STD-161 and as indicated. Provide pressure sensitive labels for flow direction and identification of piping as indicated instead of stenciling. Contractor shall place labels in locations as required by Contracting Officer.

2.14 INSTRUMENT VALVES

Instrument valves for mounting single port, pressure sensing, instruments shall be needle type valves which allow mounting of pressure gauge on vertical or horizontal header. Instrument valves shall be bar stock valves with 1/2-inch male NPT and with an integral body mounted manual bleed valve for depressuring gauge side of valve. Instrument valves for mounting on carbon steel lines shall have carbon steel bodies and stainless steel trim. Instrument valves for mounting on stainless steel lines shall have stainless steel bodies and trim. Provide operation and maintenance manual.

2.15 UNLOADING DRY BREAK COUPLER

Coupler shall mate with 4-inch adapters conforming to API 1584. All wetted parts shall be aluminum or stainless steel. Shall have an interlock such that coupler cannot be opened unless coupled to adapter. Unit cannot be uncoupled from an adaptor while in the open position. Provide dust cap.

2.16 QUICK COUPLING

Provide a dry break cam and groove style coupler with dust plug in size indicated. Material of coupler and plug shall be stainless.

PART 3 EXECUTION

3.1 WELDING

3.1.1 General

All joints unless indicated otherwise, in carbon steel and stainless steel piping systems shall be welded. Unless otherwise approved, all girth welds shall be complete penetration groove welds made in accordance with qualified welding procedures. Welding operations, qualifications of welders and welding procedures shall comply with the provisions of ASME B31.3 and the requirements specified herein. To minimize slag formation on the inside of pipes root pass on stainless steel and carbon steel pipe shall be by the GTAW process using only unfluxed welding rods, fluxed rods shall not be used on root passes.

a. Definitions shall be in accordance with AWS A3.0.

b. Symbols shall be in accordance with AWS A2.4 for welding and nondestructive testing, unless otherwise indicated.

c. Safety Precautions shall conform to ANSI Z49.1.

d. Weld Preparation shall comply with the requirements of ASME B31.3 and the qualified Welding Procedure Specification. The use of "rice paper" as purge blocks is not permitted. Contractor shall submit alternate method for approval.

e. Backing Rings. The use of backing rings for making or repairing welds shall not be permitted.

3.1.2 Qualifications of Welders

Welders and welding procedures shall be qualified in accordance with requirements of ASME B31.3. Submit for each pipe material a Welding Procedure, a Welding Procedure Qualification and Welder Qualifications to the submitted Welding Procedure for each welder.

3.1.2.1 Weld Identification

Each qualified welder shall be assigned an identification symbol. All welds shall be permanently marked with the symbol of the individual who made the weld.

3.1.2.2 Defective Work

Welders found making defective welds shall be removed from the work or shall be required to be requalified in accordance with ASME B31.3.

3.1.3 Tests

All steel pipe field welds, including high point vent pipe and low point drain pipe, shall be examined by radiographic methods to determine conformance to the paragraph "Standards of Acceptance." The services of a qualified commercial or testing laboratory approved by the Contracting Officer shall be employed by the Contractor for testing of piping welds. Costs of testing, including retesting or repaired welds, shall be borne by the Contractor.

3.1.3.1 Radiographic Inspection

Procedures for radiographic inspection shall be in accordance with MIL-STD-271 or ASTM E 94. Weld ripples or surface irregularities that might mask or be confused with the radiographic image of any objectional defect shall be removed by grinding or other suitable mechanical means. The weld surface shall be merged smoothly with the base metal surface.

3.1.4 Standards of Acceptance

Interpretation of test results and limitations on imperfections in welds shall comply with the requirements for 100 percent Radiography, per ASME B31.3, Chapter VII, Table K341.3.2A.

3.1.5 Corrections and Repairs

Defects shall be repaired in accordance with approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Whenever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners. After a defect is thought to have been removed, and prior to rewelding, the area shall be examined by suitable methods to insure that the defect has been eliminated. After repairs have been made, the repaired area shall be reinspected and shall meet the standards of acceptance for the original weld. Any indication of a defect shall be regarded as a defect unless reevaluation by nondestructive methods and/or by surface conditioning shows that no defect is present.

3.1.5.1 Defect Removal

Defective or unsound weld joints shall be corrected by removing and replacing the entire weld joint, or for the following defects corrections shall be made as follows:

a. Excessive Convexity and Overlap: Reduce by removal of excess metal.

b. Excessive Concavity of Weld, Undersized Welds, Undercutting: Clean and deposit additional weld metal.

c. Excessive Weld Porosity, Inclusions, Lack of Fusion, Incomplete Penetration: Remove defective portions and reweld.

d. Crack in Weld or Base Metal: Remove crack throughout its length, including sound weld metal for a distance of twice the thickness of the base metal or two inches, whichever is less, beyond each end of the crack, followed by the required rewelding. Complete removal shall be confirmed by magnetic particle inspection for carbon steel or liquid penetrant inspection for stainless steel. Inspection procedures shall comply with the requirements of ASME B31.3.

e. Poor Fit-Up: Cut apart improperly fitted parts, and reweld.

3.1.5.2 Methods of Defect Removal

The removal of weld metal or portions of the base metal shall be done preferably by chipping, grinding, sawing, machining, or other mechanical means. Defects also may be removed by thermal cutting techniques. If thermal cutting techniques are used, the cut surfaces shall be cleaned and smoothed by mechanical means. In addition, at least 1/8-inch of metal shall be removed by mechanical means from the cut surfaces of stainless steel.

3.1.5.3 Rewelding

Repair welds shall be made using an electrode or filler wire preferably

smaller than that used in making the original weld. Rewelding shall be done using qualified welding procedures. The surface shall be cleaned before rewelding. Repair welds shall meet the requirements of this specification.

3.1.5.4 Peening or Caulking

The use of force (peening) or foreign materials to mask, fill in, seal, or disguise any welding defects shall not be permitted.

3.2 INSTALLATION

3.2.1 Precautions

Special care shall be taken by the Contractor to insure that the protective coating on buried pipe is not damaged during installation and that the completed system is free of rocks, sand, dirt, and foreign objects. The Contractor shall take the following steps to insure these conditions.

a. Coated pipe shall be handled only with canvas or nylon slings or padded clamps. Any coating damaged by improper handling or storage shall be repaired as specified.

b. Pipe brought to the site shall be stored on blocks or horses at least 18 inches above the ground. Padded blocks or horses shall be used for coated pipe. The method and height of storing coated pipe shall be in accordance with the coating manufacturer's instructions.

c. Visual inspection shall be made of the inside of each length of pipe to ensure that it is clear and clean prior to installation.

d. The open ends of the pipe system shall be closed at the end of each day's work or when work is not in progress and shall not be opened until the work is resumed.

e. A swab, with a leather or canvas belt disc to fit the inside diameter of pipe, shall be pulled through each length of pipe after welding in place.

f. Obstruction remaining in the pipe after completion of the system shall be removed at the expense of the Contractor.

g. **Completed piping segments shall be drained of water. Purge the pipe interior with nitrogen until all the air and water has been removed from the piping interior. Monitor and record the humidity from the nitrogen exhaust. Stop nitrogen filling when the nitrogen exhaust humidity is zero.**

3.2.2 Protective Coatings

3.2.2.1 Application of Tape Wrapping

Surfaces to receive tape shall be clean, dry, grease-free and dust-free. Fusion bonded epoxy coating and adhesive undercoat surfaces to be tape

wrapped shall be primed with a compatible primer prior to application of the tape. The primer shall be as recommended by the tape manufacturer and approved by the fusion bonded epoxy coating manufacturer. Weld beads shall be wire brushed. Burrs and weld spatter shall be removed. Weld beads shall be covered with one wrap of tape prior to spiral wrapping. Fittings shall be wrapped spirally beginning with one complete wrap three inches back from each edge of the fusion bonded epoxy coating. For pipe less than four-inch size, one layer half-lapped shall be used. For pipe four-inch size and larger, two layers half-lapped shall be used, with the second layer wrapped opposite hand to the first. On irregular surfaces one layer shall be applied half-lapped and stretched to conform to the surface, followed by a second layer half-lapped and applied with the tension as it comes off the roll.

3.2.2.2 Inspection and Testing

The condition of factory coated, field coated and wrapped piping shall be the responsibility of the Contractor and all damage to the protective covering during transit and handling shall be repaired by the Contractor at no additional cost to the Government. All field coating and wrapping shall be subject to approval by the Contracting Officer. The entire pipe shall be inspected as specified in sub-paragraph "Testing of Protective Coatings" under paragraph "Protective Coatings for Buried Carbon Steel and Stainless Steel Piping." The inspection for holidays shall be performed just prior to lowering the pipe into the ditch and every precaution shall be taken during lowering and backfilling to prevent damage to the protective covering.

3.2.2.3 Damage Repair

Damaged areas of fusion bonded epoxy coating shall be repaired by tape wrapping as specified in the preceding paragraph for fittings. All areas to be taped shall be primed, and the tape shall be applied half-lapped.

3.3 VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.4 CLEANING OF PIPING

The Contractor shall keep the interior and ends of all new piping affected by the Contractor's operations thoroughly cleaned of foreign matter and water before and after being installed. Piping systems shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of piping and fittings shall be closed so that no water or other foreign substance shall enter the pipes or fittings. Piping shall be inspected before placing into position. The interior of each length of pipe shall be cleaned after welding. The Contractor shall take all actions necessary to keep the interior of all installed piping free of dirt, loose and adherent weld slag, construction debris, water and other foreign matter that may be harmful to valves, mobile refueling equipment or aircraft.

3.5 TRENCHING AND BACKFILLING

Trenching and backfilling shall conform to Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and the following bedding and backfill requirements. The pipe shall be laid in a bed of sand six inches deep, compacted to the elevation of the bottom of the pipe. The full length of each section of pipe without any protective covering shall be excavated to permit installation of the protective covering. Pipe that has the grade or joint disturbed after laying, shall be taken up and relaid. Pipe shall not be laid in water or when the trench or weather conditions are unsuitable for such work. After testing and application of protective covering to joints, sand backfill shall be placed and compacted around the pipe or protective coating. The remainder of the backfill shall be the same as for other types of pipe.

3.6 INSTALLATION OF UNDERGROUND PIPE

Underground fuel pipelines shall be pitched as shown on the drawings. Where not indicated they shall be pitched a minimum of 2 inches per 100 feet. Branch lines to the hydrant pits shall slope up to the pit. Two-inch pipe size valved drain connections shall be provided at all low points and 1 1/2-inch pipe size valved outlet vent connections shall be provided at all high points. Vent and drain lines shall terminate in male cam-type locking end dry breaks with matching female dust covers and installed in pits. The pipe shall have cover as shown on the drawings. Drain lines shall be installed at the slopes indicated.

3.6.1 Pipe Assembly

Pipe shall be strung parallel and adjacent to or above a trench. The pipe shall be supported on padded skids during welding and inspection of joints. Protective coating shall be inspected and repaired prior to lowering the pipe into the trench. The pipe shall be lowered using only canvas or nylon slings. The sling shall be dug from underneath the pipe after placements and shall not be pulled from underneath the pipe while in contact with it. Care shall be taken to prevent damage to the pipe, welded joints or coating and any such damage shall be repaired as directed by the Contracting Officer. Pressure testing of the pipe shall be done after it has been placed in final position in the trench.

3.6.2 Warning Tapes in Earth Trenches

For the purpose of early warning and identification of buried pipes outside of building walls during future trenching or other excavation, continuous identification tapes shall be provided in the trench. Tape shall be nonmagnetic plastic tape or aluminum foil plastic backed tape manufactured for the purpose of early warning and identification of utilities buried below the tape. Tape shall be at least three inches in width. Color of tape shall be as standard with the manufacturer with respect to the type of utility buried below the tape. Tape shall have lettering at least one inch high with not less than the following identification on the tape: BURIED JET FUEL PIPING BELOW. Tape shall be installed in accordance with the printed recommendations of the tape manufacturer, as modified herein.

Tapes shall be buried at a depth of six inches from the top of the subgrade.

3.6.3 Clearances

Install pipe to be clear of contact with other pipes, pipe sleeves, casings, reinforcing steel, conduits, cables, or other metallic structures. Where pipes cross other pipes or structures with a separation of less than six inches, install an insulating separator. Protect the pipe from contact with a 12-inch square by 1 inch thick bituminous-impregnated cane fiber board.

3.6.4 Protective Coating

When the protective coating on pipe is damaged, the Contracting Officer shall be notified and shall inspect the pipe before the coating is patched. If the damage to the pipe is deeper than 0.050-inch, the damage shall be repaired by welding in accordance with paragraph "WELDING". If the pipe is dented, out of round or damaged to the point that welding will not make it good as new, the length of pipe shall be rejected.

3.7 PIPING LAYOUT REQUIREMENTS

3.7.1 Pipe Fabrication

Fabricate piping to measurements established on the project site and position into place without springing or forcing. Make provisions for absorbing expansion and contraction without undue stress in any part of the system.

3.7.2 Gas Free Conditions

A number of modifications and inconnections are planned for this work. Gas free conditions are necessary to complete the work safely. All operations in the construction area that involve open flames or the possibility of arcing or sparking shall be conducted in a "Gas-Free" condition. These operations shall include but not be limited to the following:

1. Use of internal combustion engines not equipped with Underwriters' approved spark and flame eliminators.

2. Use of electric motors or electric devices with arcing brushes or sliding contacts that could produce arcing or sparking.

3. Use of tools which may produce impact sparks.

4. Electric or gas welding.

5. Use of cutting or other torches or other open-flame equipment.

6. Holiday testing.

7. Use of equipment with hot surfaces or flowing elements.

8. Use of any other equipment or procedure that could create a fire

hazard.

Contractor shall monitor the use and suitability of the equipment and procedures on the job and maintain a safe "Gas-Free" condition when necessary during construction.

Prior to commencing any phase of the Work requiring a gas-free condition, Contractor shall make the following provisions:

1. Empty pipes containing fuel and purge of all vapors.

2. Isolate, blank off, and adequately ventilate open piping sections so that no part of the pipe containing fuel or vapors is exposed.

3. Drain and ventilate fuel tanks prior to work inside tanks or on any of the tank connections.

4. Make certain that there are no open pools or reservoirs of fuel exposed in the vicinity of the Work.

5. Perform all other safety precautions necessary to ensure that these operations are conducted in a safe manner in accordance with all applicable codes.

Use a combustible gas analyzer to make certain no combustible gas concentrations exist in the construction are when performing these operations.

3.7.3 Interferences and Measurements

Provide offsets, fittings, and accessories required to eliminate interferences and to match actual equipment connection locations and arrangements. Verify measurements before commencing work. Submit discrepancies for clarification before proceeding with the installations to the Contracting Officer.

3.7.4 Space and Access

Keep piping, control tubing, which is not detailed close to structures and columns so as to take up a minimum amount of space. Ensure that access is provided for maintenance of equipment, valves and gauges.

3.7.5 Location

Do not place unions in locations that will be inaccessible after the completion of the work. Place unions on each side of equipment.

3.7.6 Piping and Equipment

Provide anchors where required to absorb or transmit thrust or eliminate vibration or pulsation. Provide hangers and supports near each change of direction. Select support components which do not restrict the movement of the pipe due to thermal expansion. Space hangers uniformly and arrange symmetrically.

3.7.7 Structural Support

Provide supplementary or intermediate steel or other structural members as required for transmission of loads to members forming part of the supporting structure.

3.7.8 Grade

Where profiles of piping lines are shown on the drawings, grade the line uniformly between changes in slope or direction. Maintain gradient to within ± 1/4-inch over the entire length of pipe. Provide survey of final elevation of buried fuel pipe. When backfilling has been completed to the top of the pipe, the pipe shall be surveyed at each joint, logged by station number, and submitted to the Contracting Officer and approved before backfilling can continue.

3.7.9 Size Changes

Make changes in pipe size with reducing fittings. Do not use bushings. In lieu of welding reducing outlet tees for piping 2 inches and larger, welding branches suitable for 100 percent radiographic inspection may be used. Do not use weldolets unless specifically called out (labeled) on the drawings.

3.7.10 Direction Changes

Make changes in the horizontal direction of pipes with long radius fittings. Provide special fittings when required. Do not make miter welds. Make odd-angle offsets with pipe bends or elbows cut to the proper angle.

3.8 TESTING

Piping shall be tested by pneumatic and hydrostatic pressure. Testing shall comply with applicable requirements of ASME B31.3, NFPA 30 and the requirements specified herein. Hydrostatic testing shall be performed using fuel, JP-8, as the liquid. Water shall not be introduced into the system for testing. Pressure and hydrostatic testing shall be performed only after welding inspection has been completed.

3.8.1 General

Piping to be installed underground shall not receive field applied protective covering at the joints or be covered by backfill until the piping has passed the pneumatic test described herein. To facilitate the tests, the Contractor shall isolate various sections of the piping system and test each one separately. Where such sections terminate at flanged valve points, the line shall be closed by means of blind flanges in lieu of relying on the valve. The Contractor shall furnish tapped flanges that can be attached to the end of the section of line being tested, and that will permit a direct connection between the piping and the air compressor and/or pressurizing pump. No taps in the permanent line shall be permitted. The Contractor shall furnish all necessary equipment for testing; all gauges

shall be subject to testing and approval of the Contracting Officer. The air used for pneumatic testing shall have a residual humidity of not over 20 percent. The Contractor shall provide dehumidifying equipment on the suction or discharge side of the air compressor used to provide air for testing. Pressurizing pump shall not exceed 10 cfm.

3.8.1.1 Pneumatic Test

Special safety measures, including the wearing of face mask, shall be taken during testing under pressure. Only authorized personnel shall be permitted in the area during testing. Use dry compressed air at 20 degrees F. The pneumatic test pressure shall be applied in increments. A preliminary 25 psig test shall be applied. Examine joints with soap solution. Leaks revealed by this test shall be repaired. Increase the pressure in steps and hold the pressure long enough to equalize the pipe strains until the full test pressure has been applied. Unless otherwise directed by the Contracting Officer, all piping shall be tested at a pressure of 100 psig for not less than 2 hours, during which time there shall be no drop in pressure, only pressure rises with temperature. The pressure source shall be disconnected during the final test period. Any leaks revealed by the test shall be repaired and the test repeated.

3.8.1.2 Preliminary Hydrostatic Pressure Test

Apply a liquid pressure test with a JP-8 approved by Contracting Officer to the piping segments following the pneumatic pressure test. Equipment which is not rated by manufacturer for the 400 psi test pressure shall be removed prior to testing. Install temporary connections as necessary.

The pressure shall be gradually increased until a gauge pressure which is one-half the test pressure, 200 psig, is attained, at which time a preliminary check shall be made, including examination of exposed joints in accordance with ASME B31.3. Thereafter, the pressure shall be gradually increased in steps until the test pressure of 400 psig is reached, holding the pressure at each step long enough to equalize piping strains.

The test pressure of 400 psig shall be maintained for at least 4 hours.

Decrease pressure by venting at high points and then increase again to the test pressure and hold again for a 8-hour period.

Provide calibrated temperature and pressure instruments and chart recorders to provide continuous temperature (fuel and ambient) and pressure reading variations during the tests. Record ambient and fuel temperatures. Instruments shall be calibrated for temperature and pressure immediately prior to each test. Recorder charts and test report shall be submitted to the Contracting Officer for review prior to final acceptance of piping.

Repair any leaks in a manner approved by Contracting Officer.

3.8.1.3 Final Hydrostatic Test

Upon completion of pneumatic testing, after partial backfilling and completion of Preliminary Hydrostatic Test, hydrostatically test each

complete piping system with fuel at 275 psig in accordance with ASME B31.3 and API RP 1110. No leakage or reduction in gauge pressure shall be detectable for four hours. The pressure shall be gradually increased in steps until a gauge pressure, which is one-half the test pressure, 138 psig, is attained, at which time a preliminary check shall be made, including examination of exposed joints in accordance with ASME B31.3. Thereafter, the pressure shall be gradually increased in steps until the test pressure of 275 psig is reached, holding the pressure at each step long enough to equalize piping stems. Hold pressure for 8 hours.

Provide calibrated temperature and pressure instruments and chart recorders to provide continuous temperature (fuel and ambient) and pressure reading variations during the tests. Record ambient and fuel temperature. Instruments shall be calibrated for temperature and pressure immediately prior to each test. Recorder charts and test report shall be submitted to the Contracting Officer for review prior to final acceptance of piping.

The Contractor shall furnish electricity, instruments, connecting devices, and personnel for test. Fuel shall be furnished by the Government. Defects in work provided by the Contractor shall be corrected by him at his own expense, and the test repeated until the work is proven to be in compliance with the Contract requirements.

3.8.2 Performance Testing

The completed fuel system shall be cleaned and performance tested as specified in Section 15899 SYSTEM START UP, FUELING SYSTEM. All control valves, both manual and automatic, shall be checked for leaks (any area wetted with fuel) and proper operation and adjusted, repaired or replaced to correct any defects.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 15 - MECHANICAL

SECTION 15970

PUMP CONTROL AND ANNUNCIATION SYSTEM

-- End of Section Table of Contents --

SECTION 15970

PUMP CONTROL AND ANNUNCIATION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.90	(1989; R 1994) Relays and Relay Systems Associated with Electric Power Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA IA 2	(1994) Programmable Controllers
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	(1993) Industrial Systems
NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA LS 1	(1992) Low Voltage Surge Protective Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)

ISA S18.1	(1979; R 1992) Annunciator Sequences and Specifications

UNDERWRITERS LABORATORIES (UL)

UL 508	(1993) Industrial Control Equipment
UL 1012	(1994) Power Units Other than Class 2
UL 1449	(1985) Transient Voltage Surge Suppressors

1.2 GENERAL REQUIREMENTS

Section 16050 BASIC ELECTRICAL MATERIALS AND METHODS and 16415 ELECTRICAL WORK, INTERIOR applies to this section, with the additions and modifications specified herein. The control system shall be furnished by a single supplier. See specification 15050 for other required components of the control system. The control system supplier shall be responsible for providing a fully functional control system, in accordance with the drawings and specifications, including the field devices. Installation shall be in accordance with NFPA 70. See Section 13205 STEEL TANKS WITH FIXED ROOFS for requirements for the automatic tank gauging system.

1.3 SUBMITTALS

1.3.1 GENERAL

Data shall be submitted in accordance with the overall requirements detailed in Section 16050 BASIC ELECTRICAL MATERIALS AND METHODS and 01330 SUBMITTAL PROCEDURES and the specific requirements of this section. Documents shall consist of a complete list of equipment and materials, manufacturer's descriptive and technical literature, brochures, catalog cuts, performance specifications, diagrams, and other material as stated in subsequent subparagraphs. The Contractor shall submit additional material if the listed items are not adequate to identify intent or conformance to technical requirements. Any delays associated with resubmittals of incomplete or ambiguous initial submittals will be the Contractor's responsibility.

1.3.2 Submittals

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pump Control Panel (PCP) and Components; G

Programmable Logical Controller (PLC) Hardware and Software; G

Graphics Display Panel; G

Documents demonstrating the accuracy and completeness of the list of material and components, that items proposed comply fully with contract requirements, and are otherwise suitable for the application indicated. Documents shall consist of all data or drawings published by the manufacturer of individual items listed including manufacturer's descriptive and technical literature, performance data, catalog cuts, and installation instructions.

Tools and Spare Parts

SD-02 Shop Drawings

Shop Drawing; G

SD-07 Certificates

Experience and Qualifications; G

Plan for Instructing Personnel; G

Testing Plan; G

SD-06 Test Reports

Certified Pump Control Panel (PCP) Shop Test Report

Record of Test

SD-10 Operation and Maintenance Data

In addition to the operation and maintenance information requested in this section, see Section 01730, Facility Operation and Maintenance Manual, for additional information to be submitted for each item of equipment and each system.

Operation and Maintenance Manuals; G

Six copies of Operational and Maintenance manuals, within 7 calendar days following the completion of factory tests.

Operational and Maintenance manuals shall be furnished following the completion of shop tests and shall include:

a. Pump Control Panel and Graphics Display Panel assembly including interior and exterior equipment layout.

b. All documents previously submitted and approved with all comments and field changes annotated.

c. Complete description of the sequence of operation including that described in Paragraphs 3.6 through 3.13 of this specification and

any subsystems not controlled by the PLC (e.g. annunciator panel, EPDS, etc.)

d. Complete listing of all programming of the PLC and Graphical Interface.

e. Complete relay ladder logic diagrams, PLC input/output diagrams and control power distribution diagrams for the complete control system.

f. Complete guide outlining step-by-step procedures for system startup and operation.

g. Complete troubleshooting guide, which lists possible operational problems and corrective action to be taken.

h. Complete maintenance and installation manual for all equipment supplied.

i. Spare parts data, which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked.

j. The above shall incorporate all as-built conditions.

Documents shall be bound in a suitable binder adequately marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

1.4 SYSTEM OVERVIEW

1.4.1 General

The Hydrant Fueling System consists of fueling pumps that pump fuel to fuel pits located on the airfield apron. Automatic pump starts and stops are based on system pressure and flow. Programmable Logic Controllers (PLCs) receive information from pressure transmitters and other devices to control the pumps and control valves. There are two PLCs that are connected in a configuration that if one fails, the other PLC will take over. The Hydrant Fueling System also includes above ground fuel storage tanks and product recovery tanks. The pump control panel and annunciator are located in the Control Room of the Pump house. The PLC also provides control functions for the truck fill and off-loading systems.

1.5 EXPERIENCE AND QUALIFICATIONS

Submit the following data for approval:

a. Certification stating that the manufacturer has manufactured and installed at least three PLC-based systems for automatic cycling of

pumps based upon varying dispensing demands ranging from 0 to 2400 gallons per minute utilizing multiple pumps. At least one of the three PLC-based systems shall be for dispensing jet fuel into aircraft fuel tanks.

b. Certification that the control systems have successfully operated over the last 2 years and are currently in service.

c. Project names, locations, and system description of these installations. Include user point-of-contact and current telephone numbers.

1.6 WARRANTY

The Pump Control and Annunciation System including devices, hardware and software shall be warranted for a period of 1 year from the date of acceptance of the system by the Government. This warranty service shall include parts and labor service for equipment supplied under this specification. Upon notification by the Government of system or component failure, the Contractor shall respond at the site with necessary parts within 48 HOURS of notification.

PART 2 PRODUCTS

2.1 PUMP CONTROL PANEL (PCP) AND COMPONENTS

2.1.1 Enclosure

NEMA ICS 1, NEMA ICS 6, NEMA 250, and UL 508. The PCP enclosure shall be a freestanding NEMA Type 12, smooth, gasketed enclosure constructed of 12 gauge steel. All seams shall be continuously welded and there shall be no drilled holes or knockout prior to delivery to the job site. The pump control panel dimensions shall be a maximum of 90 inches high, maximum 72 inches wide, and a maximum of 24 inches deep and shall have removable lifting eyes. The interior surfaces of the panel shall be properly cleaned, primed, and spray painted with white high-gloss enamel. Exterior surfaces shall have standard factory finish. Access for the PCP shall be front only and shall consist of hinged doors having 3-point latching mechanisms. The doors shall open approximately 120 degrees. Rack mounting angles, swing-out panels and other component mounting hardware shall be installed such that servicing of one component shall not require removal or disconnection of other components. No clearance shall be required between the back of the panel and the room walls. Terminal facilities shall be arranged for entrance of external conductors from the top or bottom of the enclosure. The Graphic Display Panel may be fed from the side of the PCP enclosure.

2.1.2 Ventilation System

Two supply fans, single phase, 115 volt, shall be provided. Each fan shall supply a minimum of 100 CFM. The supply and exhaust grill shall contain a filter that is easily removed from the exterior of the enclosure. Three thermostats with an adjustable set point range of 70^{O}F to 140^{O}F shall also be provided. The thermostats shall be located near the top in the interior

of the PCP.

2.1.3 Ground Bar

The control panel shall have a tin plated copper equipment ground bar. The bar shall have a minimum of twenty grounding screws.

2.1.4 Standard Indicator Lights

NEMA ICS 1, NEMA ICS 2, and UL 508. Lights shall be heavy duty, NEMA 13, 22.5 mm mounting hole, round indicating lights operating at 120 volts ac/dc or 24 volts ac/dc. Long life bulbs shall be used. Indicator lights shall have a legend plate with words as shown on drawings. Lens color as indicated on the drawings. Lights shall be "push to test (lamp)" type.

2.1.5 Selector Switches

NEMA ICS 1, NEMA ICS 2, and UL 508. Non-illuminated lever operated selector switches shall be heavy duty, NEMA 13, round, and utilize a 22.5mm mounting hole. They shall have the number of positions as indicated on the drawings. Switches shall be rated 600 volt, 10 amperes continuous. Legend plates shall be provided with each switch with words as indicated on the drawings.

2.1.6 Pushbuttons

NEMA ICS 1, NEMA ICS 2, and UL 508. Non-illuminated pushbuttons shall be heavy duty, NEMA 13, round, utilize a 22.5mm mounting hole, and have the number and type of contacts as indicated on the drawings or elsewhere in the specifications. The emergency stop switch shall be a red mushroom head, 1.5 inch diameter, momentary contact type. Pushbuttons shall be rated 600 volt, 10 amperes continuous. Legend plates shall be provided with each switch with words as indicated on the drawings.

2.1.7 Relays

ANSI C37.90, NEMA ICS 2, UL 508.

2.1.8 Nameplates

Nameplates shall be made of laminated plastic with black outer layers and a white core. Edges shall be chamfered. Nameplates shall be fastened with black-finished round-head drive screws or approved nonadhesive metal fasteners.

2.1.9 Transient Voltage Surge Suppression Devices

IEEE C62.41 for Category "B" transients, NEMA LS 1, UL 1449.

2.1.10 Terminal Blocks

NEMA ICS 4. Terminal blocks for conductors exiting the PCP shall be two-way type with double terminals, one for internal wiring connections and the other for external wiring connections. Terminal blocks shall be made

of bakelite or other suitable insulating material with full deep barriers between each pair of terminals. A terminal identification strip shall form part of the terminal block and each terminal shall be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

2.1.11 Power Conditioners (Constant Voltage Transformer Type)

UL 1012. Input voltage shall be 120 volts (nominal), 1 phase, 60 Hertz.

Output voltage regulation shall be +/-5.0% for the following conditions:

a. 20% to 100% load on output.
b. Input voltage variation of -15% to +10%.
c. Constant load power factor between 80% and 100%.

Response time shall be 1.5 cycles or less.

2.1.12 Miscellaneous Power Supplies

UL 1012. Certain field devices may require power other than 120VAC (i.e. 24VDC). The power supplies shall be convection cooled, have fully isolated independent outputs, have constant voltage, have short circuit and overvoltage protection, and have automatic current limiting.

2.1.13 Alarm Annunciator

UL 508 and ISA S18.1. The Alarm Annunciator shall provide visual annunciation, local and remote monitoring, constant or flashing visual and audible alarm as specified herein. The annunciator shall be completely solid state with no moving parts. The annunciator shall be furnished with cabinet and hardware appropriate for flush mounting on the control panel. A power supply either integral or separately mounted shall operate on 120 volts, 60 Hertz. The annunciator shall have windows arranged in a matrix configuration (rows and columns). Each window shall be at least 15/16 inch high by 1-5/8 inches wide and shall have rear illuminated translucent engraved nameplate. Lettering shall be at least 5/32 inches high. System lamp voltage shall be 24 to 28 volts dc.

2.1.14 Alarm Horns

UL 508. The alarm horns shall consist of 2-vibrating horns and 1-resonating horn. One vibrating horn is to be mounted in the PCP, and one vibrating and one resonating horn shall be mounted outside of the control room as shown on the drawings. The exterior horns shall each produce 100db at 10 feet and shall be provided in a weather proof housing. The PCP horn shall produce 70db at 10 feet.

2.1.15 4 Pen Recorder

UL 508. The recorder shall be totally enclosed in a case suitable for flush or semiflush mounting and have:

a. Four channels for multipoint recording of input data
b. Digital printer for periodic printout of chart speed, date, time, channel tags, scale, engineering units, etc.
c. 5 x 7 dot matrix, 20 character (minimum digital display) for display of input values, engineering units, setup parameters, etc.
d. Function keys for setup and control
e. Power on/off switch.

The recorder shall meet or exceed the following:

a. Input Signal	4-20mA
b. Accuracy	0.5% of calibrated span
c. Repeatability	0.25% of calibrated span
d. Input/Pen Motion	linear/continuous
e. Speed of Response	less than 2 seconds for full scale travel
f. Pen Drive	Servo motor with overrange protection
g. Pens	long lasting disposable marker in highly visible contrasting colors
h. Chart Speed	Variable with 1 inch/hour to 8 inches/hour minimum
i. Plotting Chart	Removable chart cassette with 4" nominal width Z-fold strip chart, minimum 50 feet long

2.1.16 Operator Interface Panel

UL 508. The operator interface panel shall be a NEMA 4/12, 14" color VGA CRT with sealed membrane keypads for data entry. It shall include a Pentium CPU operating at a minimum of 133MHz. It shall be mounted through the PCP door as shown on the drawings. The operator interface shall communicate with the PLCs to display system status and change system set points. The operator interface shall have run-time graphical software to display the graphical screens that were downloaded from the Laptop computer and change set points.

2.1.17 Laptop Computer

2.1.17.1 Hardware

The following are the minimum hardware requirements for the laptop computer:

a. Latest Pentium CPU or compatible
b. 32-48K Meg RAM
c. 1 - 2 G hard drive
d. 3 1/2" floppy drive
e. Color VGA LCD screen 12.1"
f. Keyboard
g. Pointing device (e.g. mouse, track ball)
h. Parallel communication port
i. Serial communication port compatible with PLC (e.g. RS-232-C, RS-485)
j. 120VAC and Battery power supply
k. All cables and connectors for interfacing with PLC and operator

interface panel

l. Modem compatible for remote troubleshooting of the system

2.1.17.2 Software

The following is the minimum software to be loaded on the laptop. The software shall be the most current versions and compatible with each other to make a complete and usable system. All software shall be year 2000 compliant.

a. Operating system (e.g. MS-DOS, Windows, OS/2)
b. Software for programming the PLC
c. Software for programming the operator interface panel

2.2 PROGRAMMABLE LOGICAL CONTROLLER (PLC) HARDWARE AND SOFTWARE

2.2.1 General

a. NEMA IA 2. Each PLC shall be able to receive discrete and analog inputs and through its programming it shall control discrete and analog output functions, perform data handling operations and communicate with external devices and remote I/O racks. The PLCs shall be a modular, field expandable design allowing the system to be tailored to the process control application. The capability shall exist to allow for expansion to the system by the addition of hardware and/or user software. At a minimum the PLCs shall include mounting backplanes, power supply modules, CPU module, communication modules, and I/O modules. The PLC software shall be year 2000 compliant.

b. Each PLC provided shall be designed and tested for use in the high electrical noise environment of an industrial plant. The PLC modules shall comply with the Federal Communication Commission's Standard 15J Part A for radio noise emissions. The programmable controller processor shall be able to withstand conducted susceptibility tests as outlined in NEMA ICS 2, NEMA ICS 3, ANSI C37.90.

c. The PLCs shall function properly at temperatures between 32 and 122 degrees F, at 5 to 95 percent relative humidity non-condensing and have storage temperatures between -40 and +140 degrees F at 5 to 95 percent relative humidity non-condensing.

d. The PLCs shall have manufacturer's standard system status indicators (e.g. power supply status, system fault, run mode status, back-up battery status).

2.2.2 Central Processing Unit Module

The CPU shall be a modular self-contained unit that will provide time of day, scanning, application (ladder rung logic) program execution, storage of the application program, storage of numerical values related to the application process and logic, I/O bus traffic control, peripheral and external device communications and self-diagnostics.

2.2.3 Power Supply Module

a. The power supply module shall be plugged into the backplane not separately mounted. The power supply shall be wired to utilize 120 VAC, 60 Hz power, the system shall function properly within the range of -10% to +15% of nominal voltage. The power supply shall provide an output to the backplane at a wattage and voltage necessary to support the attached modules. A single main power supply module shall have the capability of supplying power to the CPU module and local communication and I/O modules. Auxiliary power supplies shall provide power to remote racks.

b. Each power supply shall have an integral on/off disconnect switch to the module. If the manufacturers standard power supply does not have an on/off disconnect switch a miniature toggle type switch shall be installed near the PLC and clearly labeled as to its function.

c. The power supply shall monitor the incoming AC line voltage for proper levels and have provisions for both over current and over voltage protection. If the voltage level is detected as being out of range the system shall have adequate time to complete a safe and orderly shutdown.

2.2.4 Program Storage/Memory Requirements

a. The PLC shall have the manufacturers standard nonvolatile executive memory for the operating system. The PLC shall also have EEPROM (Electrically Erasable Programmable Read Only Memory) for storage of the user program and battery backup RAM for application memory. The EEPROM shall be loaded by use of the laptop computer.

b. The contractor shall submit a calculation of the required amount of EEPROM and RAM (random access memory) needed for this application plus an extra 50 percent.

c. The number of times a normally open (N.O.) and/or normally closed (N.C.) contact of an internal output can be programmed shall be limited only by the memory capacity to store these instructions.

2.2.5 Input/Output (I/O) Modules

a. The Contractor shall provide all required I/O modules (analog input, analog output, discrete input, discrete output, and isolated discrete output) to manipulate the types of inputs and outputs as shown on the drawings and to comply with the sequence of operations. The Contractor shall also provide a minimum of 20% (round up for calculation) spare input and output points of each type provided, but not less than 2 of each type.

b. I/O modules shall be a self-contained unit housed within an enclosure to facilitate easy replacement. All user wiring to I/O modules shall be through a heavy-duty terminal strip. Pressure-type screw terminals shall be used to provide fast, secure wire connections. The terminal block shall be removable so it is possible to replace any input or output module without disturbing field wiring.

c. During normal operation, a malfunction in any remote input/output channel shall affect the operation of only that channel and not the

operation of the CPU or any other channel.

d. Isolation shall be used between all internal logic and external power circuits. This isolation shall meet the minimum specification of 1500 VRMS. Provide optically isolated I/O components which are compatible with field devices.

e. Each I/O module shall contain visual indicators to display ON/OFF status of individual input or output points.

f. Discrete output modules shall be provided with self-contained fuses for overload and short circuit protection of the module.

g. All input/output modules shall be color coded and titled with a distinctive label.

2.2.6 Interfacing

The PLC shall have communication ports and communication modules using the manufacturers standard communication architecture for connections of the Operator Interface Panel, Laptop Computer, remote I/O racks and interconnections between SYS 1 PLC and SYS 2 PLC for the redundant backup system of the PLCs.

2.2.7 Program Requirements

a. The programming format shall be ladder diagram type as defined by NEMA IA 2.

b. There shall be a means to indicate contact or output status of the contact or output on the CRT (of the operator interface panel) or LCD screen (of the laptop computer). Each element's status shall be shown independently, regardless of circuit configuration.

c. The program shall be full featured in its editing capabilities (e.g. change a contact from normally open to normally closed, add instructions, change addresses, etc.).

2.2.8 Diagnostics

The CPU shall continuously perform self-diagnostic routines that will provide information on the configuration and status of the CPU, memory, communications and I/O. The diagnostic routines shall be regularly performed during normal system operation. A portion of the scan time of the controller should be dedicated to perform these housekeeping functions. In addition, a more extensive diagnostic routine should be performed at power up and during normal system shutdown. The CPU shall log I/O and system faults in fault tables, which shall be accessible for display. When a fault shuts down a CPU, a sequence shall be initiated that will automatically switch over to the other CPU. When a fault affects I/O or communication modules the CPU shall shut down only the hardware affected and continue operation by utilizing healthy system components. All faults shall be annunciated on the alarm annunciator.

2.3 GRAPHICS DISPLAY PANEL

2.3.1 Enclosure

The Graphics Display Panel (GDP) enclosure shall be a wall mount, NEMA Type 12, smooth enclosure constructed of 12 gauge steel. Panel dimensions shall be 36+4 inches high, 48+4 inches wide, and a maximum of 6 inches deep. The interior surfaces of the panel shall be properly cleaned, primed, and spray painted with white high-gloss enamel. Exterior surfaces shall have standard factory finish.

2.3.2 Display Presentation

The process schematic graphic representation shall be adhered to a permanent aluminum substrate. Red, green, and amber LEDS or miniature raised lens indicator lights shall be integrated with the process schematic to provide current equipment status graphically. The lights shall be a minimum of 1/2" (12 millimeters) in diameter. A lamp test push button shall also be incorporated into the panel.

2.3.3 Digital Net Flow and Level Indicators

Digital indicators shall be provided to indicate the hydrant and truck fill net flows in GPM and the levels in the product recovery tank and operating tanks. The digital indicators shall display the indicated number of digits as shown on the drawings. Each digit shall be a 7-segment red LED approximately 0.6-inches high. The indicators shall be powered by 120 VAC or 24 VDC and shall receive a 4-20mA data signal. See Section 13205 for automatic tank gauging system.

PART 3 EXECUTION

3.1 PUMP CONTROL PANEL (PCP) AND COMPONENTS

3.1.1 General

a. Wiring methods and practices shall be in accordance with NEMA ICS 1,2,3,4, and 6 recommendations as applicable. Where two or more pieces of equipment performing the same function are required, they shall be exact duplicates produced by the same manufacturer. All display instruments of each type shall represent the same outward appearance, having the same physical size and shape, and the same size and style of numbers, characters, pointers, and lamp lenses.

b. The PCP shall include all required resident software programs and hardware to provide the specified sequence of operation. All software floppy disks including programming manuals shall be turned over to the Government at the completion of start-up so modification can be done in the field with no outside assistance.

c. It is intended that process controlling devices except field devices, and motor controllers be attached to or mounted within the PCP enclosure and all interconnecting wiring installed prior to shipment to the job site. This is to allow shop testing of the system and to decrease field

labor requirements.

d. The PCP shall be shipped fully assembled in one piece after the completion of the shop tests and all defects corrected. Provide operation and maintenance manuals.

3.1.2 Shop Tests

Certified Pump Control Panel (PCP) Shop Test Report

The manufacturer shall shop test the PCP and GDP. The procedure shall include simulation of field components and shall provide for fully testing the pump control and annunciator system as a unit before delivery to the project site. The test shall, reveal system defects, including, but not limited to, functional deficiencies, operating program deficiencies, algorithm errors, timing problems, wiring errors, loose connections, short circuits, failed components and misapplication of components. The test shall be performed prior to shipment to the site and problems detected shall be corrected. The final testing and correction sequence shall be repeated until no problems are revealed and then two additional successful tests shall be performed. Submit certified test report within 15 days after completion of the test. The report shall include a statement that the Pump Control Panel performs as specified. The Contractor shall notify the Government 30 days prior to the final shop testing date. The Contracting Officer may require a Government witness at the final test before the PCP is shipped to the site.

3.1.3 Ventilation System

Thermostat T-1, shall control fan F-1 and thermostat T-2 shall control fan F-2. T-1 and T-2 shall be set at 80^{o}F to maintain interior air temperature to 20^{o}F above ambient. Thermostat T-3, set at 100^{o}F, shall provide a non-critical PCP HIGH TEMPERATURE alarm to the alarm annunciator.

3.1.4 Grounding

The PCP ground bar shall be connected to the building counterpoise via a #10 AWG conductor. Within the enclosure all I/O racks, processor racks, and power supplies, etc. shall be grounded to meet the manufacturer's specifications.

3.1.5 Indicator Lights, Switches, and Pushbuttons

Indicator lights, switches, and pushbuttons shall be mounted through the PCP enclosure and shall be arranged to allow easy vision and operation of each device. Each device shall have a nameplate and/or legend plate as indicated on the drawings. Nameplate wordings shall be as indicated on the drawings.

3.1.6 Transient Voltage Surge Suppression Devices

Transient voltage surge suppression (TVSS) devices shall be installed in the PCP to minimize effects of nearby lightning strikes, switching on and off motors and other inductive loads. TVSS shall be provided for each

control circuit ladder. Each ladder may contain any combination of the following devices: PLCs, power supplies (e.g., 24 volt), fans, relays, lights, switches etc. TVSS shall also be provided for PLC I/O originating outside of the building.

3.1.7 Terminal Blocks

As a minimum, any PCP device that connects to a field device (devices not located in the PCP) shall be connected to a terminal block. A connection diagram similar to the drawings shall be provided to the field contractor for field connections to the PCP.

3.1.8 Power Conditioners

The Pump Control Panel (PCP) shall contain three power conditioners each connected to a dedicated circuit. As shown on the drawings one power conditioner shall supply PLC System 1, one power conditioner shall supply PLC System 2, and the third power conditioner shall supply the miscellaneous device power. The power conditioners output capacity shall be sufficient to drive all the equipment connected plus 25%.

3.1.9 Power Supplies

The Contractor shall provide and install all 120VAC and 24VDC power supplies as required. The power supplies shall be sized for the load plus 25%. All field devices, which require power and are controlled or monitored from the PCP, shall be supplied from power supplies in the pump control panel. A 120V receptacle shall be provided in the PCP for use by the Laptop computer. Interconnecting wiring between power conditioners and PLC power supplies shall be completely installed prior to shipment to the job site.

3.1.10 Alarm Annunciator and Horns

Signals shall be initiated by hardwired field contacts or by PCP outputs as required. The annunciator shall energize alarm horns, both an integral panel mounted vibrating horn and remote horns, and flash the appropriate annunciator lamp. The minimum number of windows shall correspond to the number of alarm points, plus 15 percent spare. The drawings indicate panel layout and the alarms to be annunciated.

3.1.10.1 Non-critical Alarms

Non-critical alarm windows shall be white with black lettering and shall sound the PCP mounted vibrating horn and the exterior mounted vibrating horn.

3.1.10.2 Critical Alarms

Critical alarm windows shall be red with white lettering and shall sound the PCP mounted vibrating horn and the exterior mounted resonating horn. Critical alarms shall also cancel all automatic pump starts in the PLC.

3.1.10.3 Alarm Sequence

Alarm sequence for each alarm shall be as follows (ISA S18.1 sequence 'A').

a. For a normal condition, visual indicator and horns will be off.
b. For an alarm condition, visual indicator will flash and horns will sound (this condition will be locked in).
c. Upon acknowledgment of the alarm condition, visual indicator will be steady on and the horns will be off.
d. If, after acknowledgment of an alarm condition, another alarm condition is established, the new alarm will cause the appropriate window to flash and the horn to sound.
e. When condition returns to normal after acknowledgment, the visual indicator and the horn will be off.

3.1.11 4 Pen Recorder

Channel one shall record net flow (0 to 3600 GPM) for the hydrant system. Flow is measured using the Differential Pressure Transmitters (DPT) located at the issue and return venturi and net flow is the difference between the issue and return. Channel two shall record main pipeline pressure (0 to 300 psi) for the hydrant system. Pressure is measured using the Pressure Indicating Transmitters (PIT). Zero for each scale shall appear at the bottom or left side of the scale segment. Multipliers applied to these scales shall be 1 or a power of 10. Similarly, channel three is for truck fill line net flow (0 to 1800 gpm) and channel four is for truck fill line pressure (0 to 200 psi).

3.1.12 Operator Interface Panel

The operator interface panel shall be mounted through the front panel of the PCP. Conductor routing shall allow the door to swing to the fully open position. The operator interface panel shall download system parameters from the PLC for display. The operator interface shall also upload new set point values that the operator has changed using the operator interface key pad, after a password has been entered.

3.1.12.1 Screen Number 1

This shall be a general opening screen. As a minimum it shall display the name and location of the installation (e.g. Travis Air Force Base, California), name of the project (e.g., Hydrant Fueling System 'Pumphouse Baker') and screen navigation information.

3.1.12.2 Screen Number 2

At a minimum the following items shall be displayed. The values shall be continuously updated, a 2 second delay maximum between updates will be acceptable.

a. Hydrant Issue Rate xxxx GPM
b. Hydrant Return Rate xxxx GPM
c. Hydrant Net Flow xxxx GPM
d. Hydrant Pressure xxxx PSI
e. Hydrant Operation Mode Auto/Off/Flush
f. Active System Sys-1/Sys-2

g.	Lead Pump	1/2/3/4/5/6
h.	Fuel Pump #1	On/Off xxxxx.x HOURS
i.	Fuel Pump #2	On/Off xxxxx.x HOURS
j.	Fuel Pump #3	On/Off xxxxx.x HOURS
k.	Fuel Pump #4	On/Off xxxxx.x HOURS
l.	Fuel Pump #5	On/Off xxxxx.x HOURS
m.	Fuel Pump #6	On/Off xxxxx.x HOURS
n.	Backpressure Control Valve	Closed/Enabled
o.	Pressure Control Valve	Closed/Enabled
p.	Defuel/Flush Valve	Closed/Defuel
q.	Tank #3 Outlet Valve	Open/Closed
r.	Tank #4 Outlet Valve	Open/Closed
s.	Receipt Bypass Valve	Open/Closed
t.	Truck Fill Issue Rate	xxxx GPM
u.	Truck Fill Return Rate	xxxx GPM
v.	Truck Fill Net Flow	xxxx GPM
w.	Truck Fill Pressure	xxxx GPM
x.	Truck Fill Operation Mode	Auto/Off
y.	Truck Fill Lead Pump	1/2/3
z.	Loading Pump #1	On/Off xxxxx.x HOURS
aa.	Loading Pump #2	On/Off xxxxx.x HOURS
bb.	Loading Pump #3	On/Off xxxxx.x HOURS
cc.	Backpressure Control Valve-2	Closed/Enabled
dd.	Pressure Control Valve-2	Closed/Enabled

Only one of the words separated by a slash (/) shall be displayed. The xxxxx.x HOURS is the fuel pumps elapsed run time and the value shall not be lost when the lead PLC is switched. The pump and valve status words shall be color coded to match the colors used on the GDP.

3.1.12.3 Screen Number 3

The following table shall be displayed for the hydrant system. The table lists the set points that can be adjusted using the operator interface. A password shall be entered before the "current value" can be adjusted. The value entered can only be a number within the "set point range". The "default value" is the value held in the program that is loaded into EEPROM memory (This screen may require more than one display screen).

SET POINT DESCRIPTION	SET POINT RANGE	DEFAULT VALUE	CURRENT VALUE
Hydrant lead pump starting pressure	30 to 150 psi	60 psi	xxx psi
Issue flow to start second fuel pump in the sequence	450 to 650 gpm	560 gpm	xxx gpm
Issue flow to start third fuel pump in the sequence	1000 to 1300 gpm	1160 gpm	xxxx gpm
Issue flow to start fourth fuel pump in the sequence	1600 to 1900 gpm	1760 gpm	xxxx gpm

Issue flow to start fifth hydrant pump in the sequence	2100 to 2400 gpm	2260 gpm	xxxx gpm
Return flow to enable next pump in sequence to start	10 to 100 gpm	40 gpm	xxx gpm
Return flow to stop fifth, fourth, third, and second pump in the sequence (lag pump)	500 to 800 gpm	700 gpm	xxx gpm
Return flow to initiate lead pump shutdown sequence	500 to 800 gpm	560 gpm	xxx gpm
Timer to enable start-up of lead pump	0 to 120 seconds	0 seconds	xx seconds
Timer to enable second, third, fourth and fifth pumps to start	0 to 120 seconds	10 seconds	xx seconds
Timer to stop fifth, fourth, third, and second pumps	0 to 120 seconds	15 seconds	xx seconds
Timer to stop first pump	0 to 60 seconds	2 seconds	xx seconds
Timer to disable Back Pressure Control Valve	0 to 360 seconds	60 seconds	xx seconds
Timer to establish fueling pump failure	5 to 30 seconds	15 seconds	xx seconds
System pressure to stop lead pump	130 to 190 psig	140 psig	xxx psig

3.1.12.4 Screen Number 4

The following table shall be displayed for the truck fill system. The table lists the set points that can be adjusted using the operator interface. A password shall be entered before the "current value" can be adjusted. The value entered can only be a number within the "set point range". The "default value" is the value held in the program that is loaded into EEPROM memory (This screen may require more than one display screen).

SET POINT DESCRIPTION	SET POINT RANGE	DEFAULT VALUE	CURRENT VALUE
Loading Lead pump starting pressure	30 to 150 psi	60 psi	xxx psi
Truck fill issue flow			

to start second fuel pump in the sequence	450 to 650 gpm	560 gpm	xxx gpm
Return flow to enable next loading pump in sequence to start	10 to 100 gpm	40 gpm	xxx gpm
Return flow to stop second pump in the sequence (lag pump)	500 to 800 gpm	700 gpm	xxx gpm
Return flow to initiate lead loading pump shutdown sequence	500 to 800 gpm	560 gpm	xxx gpm
Timer to enable start-up of loading lead pump	0 to 120 seconds	0 seconds	xx seconds
Timer to enable second, loading pump to start	0 to 120 seconds	10 seconds	xx seconds
Timer to stop second pump	0 to 120 seconds	15 seconds	xx seconds
Timer to stop first pump	0 to 60 seconds	2 seconds	xx seconds
Timer to disable Back Pressure Control Valve	0 to 360 seconds	60 seconds	xx seconds
Timer to establish fueling loading pump failure	5 to 30 seconds	15 seconds	xx seconds
System pressure to stop loading lead pump	130 to 190 psig	140 psig	xxx psig

3.1.12.5 Screen Number 5

This screen shall be a duplicate of the Graphic Display Panel showing a schematic of the process flow.

3.1.12.6 Screen Number 6

This screen shall be a duplicate of the Alarm Annunciator and it shall be superimposed over the current active screen when an alarm is activated.

3.1.12.7 Screen Number 7

This screen shall indicate any unloading pump failure(s), and it shall be superimposed over the current active screen when an alarm is activated.

3.1.12.8 Screen Number 8

This screen shall be a "start-up" screen for the hydrant system and shall indicate the following:

Hydrant system pressure

Hydrant issue flow rate
Hydrant return flow rate
Hydrant system net flow rate
Timer to enable start-up of lead pump
Timer to enable other pumps
Timer to stop other pumps
Timer to stop first pump
Timer to de-energize BPCV
Timer to establish fueling pump failure

All parameters as programmed to stop and start pumps.

3.1.12.9 Screen Number 9

This screen shall be a "start-up" screen for the truck fill stand and shall be similar to the screen specified above for the hydrant system as follows:

Truck fill system pressure
Truck fill issue flow rate
Truck fill return flow rate
Truck fill net flow rate
Timer to enable start-up of lead pump
Timer to enable other pumps
Timer to stop other pumps
Timer to stop first pump
Timer to de-energize BPCV
Timer to establish fueling pump failure

All parameters as programmed to stop and start pumps.

3.1.13 Laptop Computer

The Laptop computer shall be used to create, edit, and load the ladder logic program into the PLC and operator interface graphics control program into the operator interface panel. The Laptop shall also be used to monitor the PLC memory and ladder logic program. The computer shall be stored in a lockable cabinet located within the Pump Control Panel.

3.2 PROGRAMMABLE LOGICAL CONTROLLER (PLC) HARDWARE AND SOFTWARE

3.2.1 General

Provide operation and maintenance manuals. The basic operation of the redundant PLC system is (Reference "Control System Block Diagram" on the drawings):

a. CPU-1 and it's associated I/O rack (I/O-1) sends system outputs to appropriate devices and receive input signals from System-1 redundant field devices (PIT-1, DPT-1, DPT-3, flow switches, valve limit switches), System-2 redundant field devices (PIT-2, DPT-2, DPT-4, flow switches, valve limit switches), and all nonredundant field devices as listed on the drawings.

b. CPU-2 and it's associated I/O rack (I/O-2) sends system outputs to

appropriate devices and receive input signals from System-1 redundant field devices (PIT-1, DPT-1, DPT-3, flow switches, valve limit switches), System-2 redundant field devices (PIT-2, DPT-2, DPT-4, flow switches, valve limit switches), and all nonredundant field devices as listed on the drawings.

c. Within each rack (I/O-1 and I/O-2) System-1, System-2, and nonredundant inputs and outputs shall not be mixed on the same input/output module.

d. Under normal operation: The system input select switch is in the "SYS-1" position. CPU-1 is controlling the system using System-1 and nonredundant inputs from I/O-1 and any set point changes from the operator interface. CPU-2 is being updated by CPU-1 or concurrently monitoring System-1 inputs from I/O-2.

e. If under normal operation CPU-1 recognizes that a System-1 input has failed (see note below) it shall change over to the System-2 redundant input on I/O-1 and report the failure to the operator interface panel alarm screen.

f. During normal operation there are two ways for CPU-2 to take control of the system: 1) CPU-1 identifies its own internal fault and hands over control to CPU-2. 2) CPU-2 identifies a fault in CPU-1 and takes control from CPU-1. When CPU-2 is in control of the system it shall annunciate the fault condition and shall be using any updated inputs from the operator interface and shall use System-1 inputs.

g. CPU-2 shall also report any of its internal faults to CPU-1 and CPU-1 shall report any faults it detects in CPU-2.

h. When the operators think the system is not working and the PLCs do not detect any faults the operator can move the system input select switch from the "SYS-1" position to the "SYS-2" position. With the switch in the "SYS-2" position the PLCs are using System-2 inputs.

3.2.2 Programs

a. The Contractor shall provide two copies of all working programs (i.e. PLC logic, operator interface) on 3-1/2 inch floppy disks as well as a printer program listing.

b. The Contractor (programmer) shall provide rung comments (documentation) in the ladder logic program. Each device, on the ladder, shall be identified as to the type of device, i.e. limit switch XX, flow indicator XX, motor starter XX, etc. Rung comments shall be provided for input and output rungs. The programmer shall also provide a comment describing the function of each rung or group of rungs that accomplish a specific function.

3.3 GRAPHICS DISPLAY PANEL

3.3.1 General

The graphic display panel shall be shipped fully assembled in one piece

after it has been shop tested as an integral part of the pump control panel and all defects corrected. Provide operation and maintenance manuals.

3.3.2 Display Presentation

The Graphic Display shall depict the process fuel flow schematically as indicated on the drawings. Red, green, and amber LEDS or miniature raised lens indicator lights shall be integrated with the process schematic to provide current equipment status graphically. Lights shall be located immediately adjacent to related equipment symbol. The lamp test button shall test all the lamps simultaneously.

3.3.3 Process Schematic

The process schematic graphic representation shall utilize conventional symbols when possible. Symbols and flow lines shall be sized and spaced so as to provide a clear representation of the system process. All background colors, component colors, lettering and detail colors shall be laminate sealed with a clear epoxy coating which is chemical resistant yet provides the clarity of a polyester finish. Provide textured nonglare finish. The Graphic Display shall be suitable for supervised field modification when future items are added. The Graphic Display shall have a white background. Minor changes may be incorporated to allow proper line width and spacing. Component arrangement, piping routing, and location of valves shall match the flow diagram. The GDP layout shall be approved by the Government prior to the construction of the GDP.

3.3.4 Digital Net Flow and Level Indicators

Digital indicators shall be panel mounted and indicate net flows in gpm and level in feet.

3.4 INSTALLATION

Installation shall conform to the manufacturer's drawings, written recommendations and directions.

3.4.1 Shop Drawing

The shop drawing shall be clear and readable and preferably drawn using a computer aided drafting package. At the conclusion of the project the diagram drawings shall be redrafted to include all as-built conditions. These updated drawings shall be included in the O&M Manuals and appropriate section of the drawings placed in a data pocket located in each of the enclosures. The shop drawing at a minimum shall show:

a. Overall dimensions, front, side and interior elevation views of the PCP showing size, location and labeling of each device.
b. Overall dimensions, front elevation of the GDP showing graphical layout and size, location and labeling of each device.
d. Power ladder diagram indicating power connections between TVSS, power conditioners, PLCs, power supplies and field and panel devices. Any terminal block connection numbers used shall be indicated.

e. Control ladder diagram indicating control connections between field and devices and PLC I/O modules. Terminal block connection numbers and PLC terminal numbers shall be indicated
f. Communication connections between PLCs and I/O racks. Communication channel numbers shall be indicated.
g. Bill of materials.
h. Written control sequence covering all inputs, outputs, and control scheme.

3.4.2 System Start-Up and Testing

a. At PCP start-up and testing the Contractor shall provide personnel, on site, to provide technical assistance, program fine tuning, and to start-up and test the system. Start-up and testing shall be coordinated with the overall fueling system start-up test specified in Section 15899, SYSTEM START-UP, FUELING. Prior to this test, all connections shall have been made between the PCP, the GDP, the motor control center, and all field devices. In addition, wiring shall have been checked for continuity and short circuits. The Contractor shall adjust set point values, timing values, and program logic as required to provide a functional hydrant fuel control system. Once the system has been fine tuned and passed the system test, the new system default values, shall be loaded into the PLC EEPROM and the operator interface screens adjusted to indicate the new values.

b. A step-by-step testing procedure of the PCP shall be submitted, Testing Plan. The test shall be designed to show that every device (lights, switches, operator interface display screens, alarms, etc.) on the PCP and GDP is in working order and that the PLC program controls the system per specifications. The test shall be performed in conjunction with Section 15899. The plan shall include a place for the contractor and government representative to initial each step of the plan after satisfactory completion and acceptance of each step. The complete initialed testing plan shall be certified by the contractor and then submitted, Record of Test.

3.4.3 Training Plan for Instructing Personnel

a. Upon completion of the system start-up a competent technician regularly employed by the PCP manufacturer shall hold a training class for the instruction of Government personnel in the operation and maintenance of the system. Provide both classroom type theory instruction and hands-on instruction using operating equipment provided. The period of instruction shall be a minimum of three 8-hour working days. The training shall be designed to accommodate 8 operators, 4 maintenance personnel, and 2 programmers. The Government shall receive written notice (via Contracting Officer) a minimum of 14 days prior to the date of the scheduled classes.

b. Furnish a written lesson plan and training schedule for Government approval at least 60 days prior to instructing operating, maintenance and programming personnel. Concurrently submit above to the MAJCOM for their input into the review process. Approval of lesson plan will be based on both Government and MAJCOM concurrence. This plan shall be tailored to suit the requirements of the Government. The training shall be divided into three separate classes. Each class shall be tailored to a specific group of personnel. The groups are: 1) Operators, those that will use the

control system on a day to day basis; 2) Maintenance personnel, those that will perform routine and non-routine maintenance and trouble shooting of the control system; 3) Programmers, those that will make changes to and trouble shoot the PLC and operator interface programs. The training program shall provide:

(1) a detailed overview of the control system including the complete step-by-step procedures for start-up, operation and shut-down of the control system.
(2) a general overview of programmable logic controllers
(3) the maintenance of equipment installed
(4) the programming of the PLC and Operator Interface
(5) trouble shooting of the system

c. Complete approved Operation and Maintenance manuals for Specification 15970 PUMP CONTROL AND ANNUNCIATION SYSTEM and 16415 INTERIOR WIRING SYSTEMS (specifically pertaining to the motor control center and its relay ladder diagrams) shall be used for instructing operating personnel. Training shall include both classroom and hands-on field instruction. The class shall be video taped in the VHS format.

d. The contractor shall also provide VHS formatted video taped training courses covering system overview, operation, maintenance, trouble shooting, and programming. These tapes shall be produced off-site by the contractor using the supplied Pump Control Panel as the teaching aid, or commercially produced tapes by the PLC manufacturer or third party who specializes in training on PLC systems. Along with the tapes, provide workbooks, which follow along with the tapes.

3.5 TOOLS AND SPARE PARTS

The following shall be provided:

a. any special tools necessary for maintenance of the equipment
b. one spare set of fuses of each type and size
c. recommended manufacturer list of spare parts. Include part number, current unit price, and source of supply.
d. one spare power supply module
e. one spare I/O module (for discrete devices)
f. one spare I/O module (for analog devices)
g. 2 PLC RAM back-up batteries
h. 5 spare pens of each color for the chart recorder
i. 5 packages of chart paper for the chart recorder
j. minimum of 10 spare lamps for the Alarm Annunciator
k. minimum of 10 spare lamps of each type of non-LED lamps used on the Pump Control Panel and Graphic Display Panel

3.6 PLC CONTROL SYSTEM SEQUENCE OF OPERATION

3.6.1 General

The following describes general functions of the fueling system components.

3.6.1.1 Abbreviations

a. SYS-1: components of System #1 including power conditioner, power supplies, CPU-1, I/O-1, and system #1 input and outputs.
b. SYS-2: components of System #2 including power conditioner, power supplies, CPU-2, I/O-2, and system #2 input and outputs.
c. CPU-1: SYS-1 PLC CPU.
d. CPU-2: SYS-2 PLC CPU.
e. I/O-1: SYS-1 PLC input/output modules.
f. I/O-2: SYS-2 PLC input/output modules.
g. PCP: Pump Control Panel.
h. GDP: Graphic Display Panel.
i. OI: Operator Interface

3.6.2 Operating Tanks

3.6.2.1 Level Control

Each operating tank has three level float switches to measure low, high and high-high levels. The switches are DPDT for the redundancy and each pole shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing.

a. Low Level

When the low level float is activated the associated tank's GDP low level light shall light. If the outlet valve is not fully closed the alarm annunciator's critical alarm sequence activates, fueling pumps running in automatic mode shall be disabled and no pump shall be allowed to start automatically. If all tanks are at low level, no fueling pumps shall start automatically.

b. High Level

When the high level float is activated the associated tank's GDP high level light shall light and the alarm annunciator's non-critical alarm sequence activates.

c. High-High Level

When the high-high level float is activated the associated tank's GDP high-high level light shall light, the alarm annunciator's critical alarm sequence activates, fueling pumps running in automatic mode shall be disabled and no pump shall be allowed to start automatically.

3.6.2.2 Outlet Valve

Each operating tank's outlet valve has a limit switch to indicate valve position. The switch is DPDT for redundancy and each pole shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. The switch shall close when the valve is fully closed. When the limit switch is closed the associated tank's valve OI closed display and GDP closed light shall activate. When the limit switch is open, the associated tank's valve OI open display and GDP open light shall activate.

3.6.2.3 Level Indication

Level data shall be supplied from the automatic tank gauging system specified in Section 13205.

3.6.3 Product Recovery Tank

3.6.3.1 Fuel Transfer Pump (FTP)

The pump's motor controller has a status relay to indicate the on/off status of the pump. The status relay shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. When status relay is open the pump's GDP off light shall light. When the status relay is closed the pump's GDP on light shall light. The status relay state shall also be used to start and stop the pumps elapsed run time timer.

3.6.3.2 High Level Alarm

The tank has a high level alarm float switch. The switch is SPST and shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. When the high level alarm float is activated the tank's GDP high level light shall light and the alarm annunciator's non-critical alarm sequence activates.

3.6.3.3 Leak Detection

The tank has a leak detection system. The leak detection systems alarm relay shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. When the leak alarm is activated the alarm annunciator's non-critical alarm sequence activates.

3.6.4 Fueling Pumps (FP)

There are six fueling pumps with a maximum of five pumps running at one time. The lead pump selector switch shall select the pump starting sequence. Each pump's motor controller has a status relay to indicate the on/off status of the pump. The status relay shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. When status relay is open the associated pump's OI off display and GDP off light shall activate. When the status relay is closed the associated pump's OI on display and GDP on light shall activate. The status relay state shall also be used to start and stop the pumps elapsed run time timer and shall be displayed on the OI.

3.6.5 Flow Switch, Fueling Pump

On the discharge side of each pump is a flow switch to indicate positive flow (fail safe feature). The flow switch is DPDT for redundancy and each pole shall be connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. If the PLC has given a signal to start a pump and the flow switch has not closed before the set point timer expires or if the flow switch opens after the pump has been running then the pump shall be in a failure state and it shall be disabled (taken out of

the starting sequence), the alarm annunciator's non-critical alarm sequence shall also be activated, and the next pump in the start sequence started. After the PLC has stopped all of the pumps, any failed pump shall be added back into the start sequence.

3.6.6 Transmitters

3.6.6.1 Pressure Indicating Transmitter (PIT)

The PIT's measure system pressure in psi. There are two PIT's for hydrant system and two for truck fill, in each case, for redundancy. PIT-1 and PIT-2 for the hydrant system and PIT-3 and PIT-4 for the truck fill system, are connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. The system pressure is sent to one channel of the 2-pin recorder and the OI display.

3.6.6.2 Differential Pressure Transmitter (PDT)

The PDT's measure flow in gpm. For the hydrant system, there are two issue PDT's (PDT-1 and PDT-2) and two return PDT's (PDT-3 and PDT-4) for redundancy. Similarly, for the truck fill system, there are two issue PDT's (PDT-5 and PDT-6) and two return PDT'S (PDT-7 and PDT-8) for redundancy. The PDTs are connected to both SYS-1 and SYS-2 as indicated on the Terminal Block Connection drawing. The net flow is sent to one channel of the 2-pin recorder and the digital indicator on the GDP. The issue rate, return rate and net flow shall be displayed on the OI.

3.6.7 Control Valves

3.6.7.1 Defuel/Flush Valve (D/FV) (Hydrant System)

The D/FV shall be connected to I/O-1, I/O-2 and power conditioner #3 as indicated on the Terminal Block Connection drawing. The GDP open and closed lights and OI display shall activate based on the PLC's output status for the valve. The valve status shall be based on the table listed below.

Defuel/Flush Valve Operation - Two Solenoids				
Fueling Mode per PCP Selector Switch	Valve Action	Solenoid A	Solenoid B	Illuminated GDP Light
Flush Mode	Open	De-Energized	Energized	Open
Automatic Mode Pump(s) On	Closed	De-Energized	De-Energized	Closed
Automatic Mode Pumps Off	Enabled	Energized	De-Energized	Closed
Off Mode Pump(s) On	Closed	De-energized	De-Energized	Closed

Off Mode Pumps Off	Enabled	Energized	De-Energized	Closed

3.6.7.2 Pressure Control Valve (PCV) Hydrant System

The PCV shall be connected to I/O-1, I/O-2 and power conditioner #3 as indicated on the Terminal Block Connection drawing. The GDP enabled and closed lights and OI display shall activate based on the PLC's output status for the valve. The valve status shall be based on the table listed below.

Pressure Control Valve Operation - One Solenoid			
Fueling Mode per PCP Selector Switch	Valve Action	Solenoid	Illuminated GDP Light
Automatic Mode Pumps Off	Enabled	De-Energized	Enabled
Automatic Mode Pump(s) On	Closed	Energized	Closed
Flush Mode Pumps On	Closed	Energized	Closed
Flush Mode Pumps Off	Enabled	De-Energized	Enabled
Off Mode Pump(s) On	Closed	Energized	Closed
Off Mode Pumps Off	Enabled	De-Energized	Enabled

3.6.7.3 Backpressure Control Valve (BPCV) Hydrant System (Truck Fill)

The BPCV shall be connected to I/O-1, I/O-2 and power conditioner #3 as indicated on the Terminal Block Connection drawing. The GDP enabled and closed lights and OI display shall activate based on the PLC's output status for the valve. The valve status shall be based on the table listed below.

Backpressure Control Valve Operation - Two Solenoids				
Fueling Mode per PCP Selector Switch	Valve Action	Solenoid 1	Solenoid 2	Illuminated GDP Light
Automatic Mode Pump Start-up	Enabled	Energized	De-Energized	Enabled
Automatic Mode Prior to Lead Pump Shutoff	Closed	De-Energized	De-Energized	Closed

Flush Mode	Closed	De-Energized	Energized	Closed
Off Mode Pump(s) On	Enabled	Energized	De-Energized	Enabled
Off Mode Pumps Off	Closed	De-Energized	De-Energized	Closed

3.6.8 Safety Circuit

3.6.8.1 Emergency Stop Status

The emergency stop circuit status relay (ER1) N.O. contact shall be connected to I/O-1, I/O-2 and power conditioner #3 as indicated on the Terminal Block Connection drawing. When the circuit is activated the alarm annunciator's critical alarm sequence is activated and any calls to start fueling pumps shall be canceled and no additional pump start signals shall be sent until the circuit has been reset. All fueling pumps shall actually be stopped by an emergency stop circuit status relay (ER2) N.O. contact in the fuel pump motor control circuit located in the motor control center (MCC2).

3.6.8.2 Emergency Shutoff Valves (ESO) Status

The ESO status relay (ER2) N.O. contact shall be connected to I/O-1, I/O-2 and power conditioner #3 as indicated on the Terminal Block Connection drawing. When the relay is closed the GDP valve open lights shall light. When the relay is open the GDP valve closed lights shall light.

3.6.8.3 Circuit Power Status

The safety circuit power status relay (ER3) N.O. contact shall be connected to I/O-1, I/O-2 and power conditioner #3 as indicated on the Terminal Block Connection drawing. When the relay is closed the PCP emergency circuit power on light shall light.

3.6.8.4 Unloading Pumps Status

The emergency stop circuit status relay ER4 N.O. contact shall be connected to I/O-1 and I/O-2 and power condition #3 as indicated on the Terminal Block Connection drawing. When the circuit is activated, any calls to start unloading pumps shall be canceled and no additional pump start signals shall be sent until the circuit has been reset. The unloading pumps shall actually be stopped by an emergency stop circuit status relay ER5 N.O. contact in the motor control center.

3.6.9 Pump Control Panel

3.6.9.1 CPU Faults

The PCP mounted CPU-1 and CPU-2 on lights are connected to both SYS-1 and SYS-2. The associated CPU light shall light when no system faults are detected. When a fault is detected by the CPU or it's redundant CPU the

faulted CPU's on light shall be turned off and the alarm annunciator's non-critical alarm sequence shall be activated.

3.6.9.2 Input Select Switch

The 2-position input select switch shall control which inputs (System-1 or System-2) are being used. Each switch position shall be connected to both SYS-1 and SYS-2. The OI display shall indicate the active system.

3.6.9.3 Mode Select Switch

The 3-position switch selects what mode of fueling is active: automatic, flush or off. Each switch position shall be connected to both SYS-1 and SYS-2. The OI display shall indicate the active mode.

3.6.9.4 Lead Pump Selector Switch

The 6-position switch selects which fueling pump shall be the lead pump. The switch position shall fix the starting sequence for all pumps. The sequences shall be 1-2-3-4-5, 2-3-4-5-6, 3-4-5-6-1, 4-5-6-1-2, 5-6-1-2-3, and 6-1-2-3-4. The off sequence shall be the reverse of the start sequence, therefore, first on will be last off. A maximum of five pumps shall be allowed to run at one time. If a pump fails to start or fails during operation, that pump shall be disabled and the next pump in the sequence started. The OI display shall indicate the lead pump.

For truck fill, the 3-position switch selects which loading pump shall be the lead pump. The switch position shall fix the starting sequence for all pumps. The sequences shall be 1-2, 2-3, and 3-1. The off sequence shall be the reverse of the start sequence, therefore, first on will be last off. A maximum of two pumps shall be allowed to run at one time. If a pump fails to start or fails during operation, that pump shall be disabled and the next pump in the sequence started. The OI display shall indicate the lead pump.

3.6.9.5 PCP Temperature Alarm

The alarm thermostat when activated shall activate the alarm annunciator's non-critical alarm sequence.

3.7 OPERATING PROGRAM REQUIREMENTS

The control system's logic program shall be stored on a EEPROM chip. Default values of operator adjustable parameters shall be permanently stored on the chip with the capability of resetting the values in RAM to the values with in the range specified below. The default values can be changed through the use of the Operator Interface Panel (after the correct password has been entered). After loss of power and battery failure the adjustable settings shall revert back to the default values located on the chip. The default values shown here shall be reset to the values determined during the system start up and test.

SET POINT DESCRIPTION	SET POINT RANGE	DEFAULT VALUE

Lead pump starting pressure	30 to 150 psi	60 psi
Issue flow to start second pump in sequence	450 to 650 gpm	560 gpm
Issue flow to start third pump in sequence	1000 to 1300 gpm	1160 gpm
Issue flow to start fourth pump in sequence	1600 to 1900 gpm	1760 gpm
Issue flow to start fifth pump in sequence	2100 to 2400 gpm	2260 gpm
Return flow to enable next pump in sequence to start	10 to 100 gpm	40 gpm
Return flow to stop fifth, fourth, third, and second pump in sequence (lag pump)	500 to 800 gpm	700 gpm
Return flow to initiate lead pump shutdown sequence	500 to 800 gpm	560 gpm
Timer to enable start-up of lead pump	0 to 120 seconds	0 seconds
Timer to enable second, third, fourth, and fifth pumps to start	0 to 120 seconds	10 seconds
Timer to stop fifth, fourth, third, and second pumps	0 to 120 seconds	15 seconds
Timer to stop first pump	0 to 60 seconds	2 seconds
Timer to de-energize (close) Back Pressure Control Valve	0 to 360 seconds	60 seconds
Timer to establish fueling pump failure	5 to 30 seconds	15 seconds
System pressure to stop lead pump	130 to 190 psig	140 psig

Should the operator enter a value not within the range for that parameter, the Operator Interface Panel shall indicate "INVALID ENTRY" and revert back to the previous value.

3.8 HYDRANT AUTOMATIC MODE - IDLE CONDITION

The fueling system is intended to remain continuously pressurized while in the idle condition. This allows the system to respond immediately to

aircraft refueling and defueling requirements. Periodically, in the idle condition, the system will lose minimal pressure. When this occurs, the control system will automatically repressurize in the following sequence:

a. The lead pump will start when the system pressure is less than 60 psig continuously for 0 seconds. If the pressure then rises above 60 psig before the timer expires, the timer shall reset.

b. After the timer expires:

(1) BPCV-1 solenoid shall be energized to enable the valve to modulate the system pressure at it's set point.

(2) PCV-1 solenoid shall be energized to close the valve.

(3) The D/FV solenoid 'A' shall be de-energized so the valve is closed and solenoid 'B' shall be de-energized.

c. With the lead pump running, "600 gpm will flow through the issue venturi. The system pressure upstream of BPCV-1 will increase to the BPCV set point of 130 psig. At this pressure BPCV-1 will start to open and the valve will modulate as required to pass sufficient flow through the return venturi to maintain pressure upstream of the valve.

d. With the lead pump running and no fueling demand the return venturi flow rate will equal the issue venturi flow rate. When the return venturi flow rate is greater than 560 gpm a 60 second timer shall start. If the flow rate drops below 560 before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

e. After the timer expires:

(1) BPCV-1 solenoid shall be de-energized to close the valve.

(2) When system pressure rises to 140 psig a 2 second timer shall start. After the timer has expired, the lead pump shall be stopped.

(3) The Defuel/Flush valve solenoid "A" shall be energized to bleed system pressure to 80 psig.

(4) PCV-1 solenoid shall be de-energized to bleed system pressure to 75 psig.

f. The system has now returned to a pressurized and idle condition.

g. When a fueling pump is called to start, a 15 second timer shall start. If the timer expires before the flow switch closes the pump shall be called off, the alarm annunciator's associated non-critical alarm sequence shall activate and the next pump in the sequence shall be called to start.

h. If a fueling pump flow switch opens after the pump has successfully started, the pump shall be turned off, the alarm annunciator's associated non-critical alarm sequence shall activate and the next pump in the

sequence shall be called to start.

3.9 HYDRANT AUTOMATIC MODE - REFUELING CONDITION

To start an aircraft fueling operation, an operator connects fueling equipment such as a hydrant hose truck to an aircraft and to a hydrant control valve. When the operator opens the hydrant control valve by use of an air operated "Deadman", the following sequence shall occur:

a. The lead pump shall start when the PIT-1 or PIT-2 senses a pressure less than 60 psig continuously for 0 seconds. If the pressure then rises above 60 psig before the timer expires, the timer shall reset.

b. After the timer expires:

(1) BPCV-1 solenoid shall be energized to enable the valve to modulate the system pressure at its set point.

(2) PCV-1 solenoid shall be energized to close the valve.

(3) The D/FV solenoid 'A' shall be de-energized so the valve is closed and solenoid 'B' shall be de-energized.

c. With the lead pump running, 600 gpm (±) will flow through the issue venturi. The system pressure upstream of the BPCV will increase to BPCV-1 set point of 130 psig. At this pressure BPCV-1 shall start to open and the valve shall modulate as required to pass sufficient flow through the return venturi to maintain pressure upstream of the valve.

d. With lead pump running and an issue venturi flow rate of 600± gpm and a return venturi flow rate greater than 40 gpm and less than 560 gpm the lead pump shall continue to run and the BPCV shall modulate to pass flow as necessary to maintain upstream system pressure.

e. With the lead pump running and an issue venturi flow rate of 600± gpm and a return venturi flow rate greater than 560 gpm, a 60 second timer shall start. If issue venturi flow rate falls below 560 gpm or the return venturi flow rate falls below 560 before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

f. After the timer expires:

(1) BPCV-1 solenoid shall be de-energized to close the valve.

(2) The Defuel/Flush valve solenoid "A" shall be energized to bleed system pressure to 80 psig.

(3) PCV-1 solenoid shall be de-energized to bleed system pressure to 75 psig.

(4) When system pressure rises to 140 psig a 2 second timer shall start. After the timer has expired, the lead pump shall be stopped.

g. With the lead pump running and a issue venturi flow rate of 600± gpm and a return venturi flow rate less than 40 gpm a 10 second timer shall start. If the issue venturi flow rate falls below 560 gpm or the return venturi flow rate rises above 40 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

h. After the timer expires: The second pump shall start.

i. With the lead and second pumps running and an issue venturi flow rate of 1200± gpm and a return venturi flow rate of greater than 40 gpm and less than 700 gpm, the lead and second pumps shall continue to run and BPCV-1 shall modulate as necessary to maintain system pressure.

j. With the lead and second pumps running and an issue venturi flow rate of 1200± gpm and a return venturi flow rate greater than 700 gpm a 15 second timer shall start. If issue venturi flow rate falls below 1160 gpm or the return venturi flow rate falls below 700 gpm before the timer expires, the timer shall reset and no changes shall be made to the pump and valve status.

k. After the timer expires: The second pump shall be stopped.

l. With the lead and second pump running and an issue venturi flow rate of 1200± gpm and a return venturi flow rate less than 40 gpm a 10 second timer shall start. If the issue venturi flow rate falls below 1160 gpm or the return venturi flow rate rises above 40 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

m. After the timer expires: The third pump shall start.

n. With the lead, second and third pumps running and an issue venturi flow rate of 1800± gpm and a return venturi flow rate of greater than 40 gpm and less than 700 gpm the lead, second and third pumps shall continue to run and BPCV-1 shall modulate as necessary to maintain system pressure.

o. With the lead, second and third pumps running and an issue venturi flow rate of 1800± gpm and a return venturi flow rate greater than 700 gpm, a 15 second timer shall start. If the issue venturi flow rate falls below 1760 gpm or the return venturi flow rate falls below 700 gpm before the timer expires, the timer shall reset and no changes shall be made to the pump and valve status.

p. After the timer expires: The third pump shall be stopped.

q. With the lead, second and third pumps running and an issue venturi flow rate of 1800± gpm and a return venturi flow rate less than 40 gpm, a 10 second timer shall start. If the issue venturi flow rate falls below 1760 gpm or the return venturi flow rate rises above 40 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

r. After the timer expires: The fourth pump shall start.

s. With the lead, second, third and fourth pumps running and an issue venturi flow rate of 2400± gpm and a return venturi flow rate of greater than 40 gpm and less than 700 gpm the lead, second, third and fourth pumps shall continue to run and BPCV-1 shall modulate as necessary to maintain system pressure.

t. With the lead, second, third and fourth pumps running and an issue venturi flow rate of 2400± gpm and a return venturi flow rate greater than 700 gpm, a 15 second timer shall start. If the issue venturi flow rate falls below 2360 gpm or the return venturi flow rate falls below 700 gpm before the timer expires, the timer shall reset and no changes shall be made to the pump and valve status.

u. After the timer expires: The fourth pump shall be stopped.

v. With the lead, second, third and fourth pumps running and an issue venturi flow rate greater than 2360 gpm and a return venturi flow rate less than 40 gpm a 10 second timer shall start. If the issue venturi flow rate falls below 2360 gpm or the return venturi flow rate rises above 40 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

w. After the timer expires: The fifth pump shall start.

x. With the lead, second, third, fourth and fifth pumps running and an issue venturi flow rate of 3000± gpm and a return venturi flow rate of greater than 40 gpm and less than 700 gpm the lead, second, third, fourth and fifth pumps shall continue to run and BPCV-1 shall modulate as necessary to maintain system pressure.

y. With the lead, second, third, fourth and fifth pumps running and an issue venturi flow rate of 3000± gpm and a return venturi flow rate greater than 700 gpm, a 15 second timer shall start. If the issue venturi flow rate falls below 2960 gpm or the return venturi flow rate falls below 700 gpm before the timer expires, the timer shall reset and no changes shall be made to the pump and valve status.

z. After the timer expires: The fifth pump shall be stopped.

aa. When a fueling pump is called to start, a 15 second timer shall start. If the timer expires before the flow switch closes the pump shall be called off, the alarm annunciator's associated non-critical alarm sequence shall activate and the next pump in the sequence shall be called to start.

ab. If a fueling pump flow switch opens after the pump successfully started the pump shall be called off, the alarm annunciator's associated non-critical alarm sequence shall activate and the next pump in the sequence shall be called to start.

3.10 HYDRANT AUTOMATIC MODE - DEFUELING CONDITION

To start an aircraft defuel operation, an operator connects a hydrant hose truck to an aircraft and a fuel sense line and an air sense line to the hydrant control valve. The hydrant hose truck has an on-board defuel pump

capable of delivering 300 gpm at 165 psig. When the operator starts the defuel operation one of the following shall occur:

a. If the fueling pumps are running (D/FV closed) the fuel being removed from the aircraft will either go to the other aircraft(s) connected to the system or be returned to the pumphouse where BPCV-1 shall modulate to control system pressure and the fuel will be returned to the operating tanks. The return venturi flow rate will control the number of pumps that are on as discussed in paragraph "AUTOMATIC MODE - FUELING CONDITION".

b. If the fueling pumps are off (D/FV enabled) the fuel being removed from the aircraft shall be returned to the pumphouse and both the D/FV and PCV-1 shall modulate to return the fuel to the operating tanks.

3.11 HYDRANT FLUSH MODE

This mode shall be used when the system needs to be flushed of water or sediment. The operators shall first place the manual valve in the desired position to select the appropriate flow path. Placing the selector switch in "flush" the following shall occur:

a. BPCV-1 solenoid shall be de-energized to force it closed.

b. The D/FV solenoid 'A' shall be de-energized to allow the valve to open and the D/FV solenoid 'B' shall be energized to force it open.

c. Start the fueling pump(s) manually using the Hand-Off-Auto or Hand-Auto switch to obtain the desired flow rate. The automatic pump starts shall be disabled in this mode.

d. PCV-1 solenoid shall be energized when pump(s) are on and de-energized when the pumps are off.

e. When a fueling pump is started, a 15 second timer shall start. If the timer expires before the flow switch closes the alarm annunciator's associated non-critical alarm sequence shall activate.

f. If a fueling pumps flow switch opens after the pump successfully started the alarm annunciator's associated non-critical alarm sequence shall activate.

3.12 HYDRANT FUELING - OFF MODE

a. Automatic starting of fueling pumps shall be disabled. All other functions (GDP, alarm annunciator, 2-pen recorder, operator interface, control valve solenoids, etc.) shall be active to allow manual control of the fueling pumps using the Hand-Off-Auto or Hand-Auto switch.

b. When the first fueling pump has been started:

(1) BPCV-1 solenoid shall be energized to enable the valve to modulate the system pressure at its set point.

(2) PCV-1 solenoid shall be energized to close the valve.

(3) The D/FV solenoid 'A' shall be de-energized so the valve is closed and solenoid 'B' shall be de-energized.

c. The second, third and fourth pumps maybe started or stopped manually as needed by the operator.

d. After the last pump has been stopped:

(1) BPCV-1 solenoid shall be de-energized.

(2) PCV-1 solenoid shall be de-energized.

(3) The D/FV solenoid 'A' shall be energized and D/FV solenoid 'B' shall be de-energized.

3.13 MANUAL OPERATION OF FUELING PUMPS

a. If the PLC system is still active see Paragraph "TRUCK FILL OFF MODE".

b. If the PLC system has no power or both CPUs have faulted (CPU lights on PCP off) the pumping system will be in a completely manual mode. The safety circuit will need power so that the ESO solenoids on the non-surge check valves will be open and fuel can flow. The solenoids on the other solenoid controlled valves will be de-energized so the valves will have to be manually opened or enabled for the system to run. Other valves may need to be opened or closed manually by the operators for the system to work properly.

3.14 UNLOADING PUMPS

a. The PLC shall start unloading pumps only if at least one of the two tanks is below high level.

b. If the level in the header/standpipe increases to the level of the second of three displacers, the PLC shall start a pump, the PLC rotating the pump to be started each time.

c. After a pump is started, the PLC shall shut off any pump associated with a flow switch that is closed for 60 seconds or more. This delay shall be programmable.

d. If the level in the standpipe rises to the level of the third level switch, the PLC shall start a second pump.

e. The PLC shall stop the second pump when the level falls to the level of the second level switch.

f. The PLC shall stop the remaining pump when the level drops to the lowest level switch.

3.15 TRUCK FILL AUTOMATIC MODE - REFUELING CONDITION

To start a truck fill operation, an operator connects fueling equipment such as a pantograph to a truck. When the operator opens the truck loading valve by use of an air operated "Deadman", the following sequence shall occur:

a. The lead pump shall start when the truck fill PIT senses a pressure less than 60 psig continuously for 0 seconds. If the pressure then rises above 60 psig before the timer expires, the timer shall reset.

b. After the timer expires:

(1) The truck fill BPCV solenoid A shall be energized to enable the valve to modulate the system pressure at its set point.

(2) The truck fill PCV-2 shall be energized to close valve.

c. With the lead loading pump running, 600 gpm (±) will flow through the truck fill issue venturi. The system pressure upstream of the truck fill BPCV will increase to the BPCV set point of 90 psig. At this pressure the BPCV shall start to open and the valve shall modulate as required to pass sufficient flow through the truck fill return venturi to maintain pressure upstream of the valve.

d. With lead pump running and a truck fill issue venturi flow rate of 600± gpm and a return venturi flow rate greater than 40 gpm and less than 560 gpm the lead pump shall continue to run and the truck fill BPCV shall modulate to pass flow as necessary to maintain upstream system pressure.

e. With the lead loading pump running and a truck fill issue venturi flow rate of 600± gpm and a truck fill return venturi flow rate greater than 560 gpm a 120 second timer shall start. If issue venturi flow rate falls below 560 gpm or the return venturi flow rate falls below 560 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

f. After the timer expires:

(1) The truck fill BPCV pressure sustaining solenoid A shall be de-energized to close the valve.

(2) The PCV-2 solenoid shall be de-energized to bleed system pressure to 75 psig.

(3) When system pressure rises to 100 psig a 2 second timer shall start. After the timer has expired, the lead pump shall be stopped.

g. With the lead loading pump running and a truck fill issue venturi flow rate of 600± gpm and a return venturi flow rate less than 40 gpm, a 10 second timer shall start. If the issue venturi flow rate falls below 560 gpm or the return venturi flow rate rises above 40 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

h. After the timer expires: The second loading pump shall start.

i. With the lead and second loading pumps running and a issue venturi flow rate of 1200± gpm and a return venturi flow rate of greater than 40 gpm and less than 700 gpm the lead and second pumps shall continue to run and the BPCV shall modulate as necessary to maintain system pressure.

j. With the lead and second pumps running and a issue venturi flow rate of 1200± gpm and a return venturi flow rate greater than 700 gpm a 15 second timer shall start. If issue venturi flow rate falls below 1160 gpm or the return venturi flow rate falls below 700 gpm before the timer expires, the timer shall reset and no changes shall be made to the pump and valve status.

k. After the timer expires: The second pump shall be stopped.

l. With the lead and second pumps running and an issue venturi flow rate of 1200± gpm and a return venturi flow rate less than 40 gpm, a 10-second timer shall start. If the issue venturi flow rate falls below 1160 gpm or the return venturi flow rate rises above 40 gpm before the timer expires, the timer shall reset, and no changes shall be made to the pump and valve status.

m. After the timer expires: The third loading pump shall start.

n. With the lead, second and third loading pumps running and an issue venturi flow rate of 1800± gpm and a return venturi flow rate of less than 700 gpm the lead, second and third pumps shall continue to run and the BPCV shall modulate as necessary to maintain system pressure.

o. With the lead, second and third pumps running and an issue venturi flow rate of 1800± gpm and a return venturi flow rate greater than 700 gpm a 15-second timer shall start. If issue venturi flow rate falls below 1760 gpm or the return venturi flow rate falls below 700 gpm before the timer expires, the timer shall reset and no changes shall be made to the pump and valve status.

p. After the timer expires: The third pump shall be stopped.

3.16 TRUCK FILL - OFF MODE

a. Automatic starting of loading pumps shall be disabled when the truck fill mode switch is placed in the Off position. All other functions (GDP, alarm annunciator, 2-pen recorder, operator interface, control valve solenoids, etc.) shall be active to allow manual control of the loading pumps using the Hand-Off-Auto or Hand-Auto switches.

b. When the first loading pump has been started:

(1) The truck fill BPCV-2 pressure sustaining solenoid shall be energized to enable the valve to modulate the system pressure at its set point.

(2) The PCV-2 solenoid shall be energized to close the valve.

c. The second and third pumps may be started or stopped manually as needed by the operator.

d. After the last pump has been stopped:

(1) The truck fill BPCV-2 solenoid shall be de-energized.

3.17 MANUAL OPERATION OF TRUCK FILL PUMPS

a. If the PLC system is still active see Paragraph "TRUCK FILL OFF MODE".

b. If the PLC system has no power or both CPUs have faulted (CPU lights on PCP off) the pumping system will be in a completely manual mode. The safety circuit will need power so that the ESO solenoids on the non-surge check valves will be open and fuel can flow. The solenoids on the other solenoid controlled valves will be de-energized so the valves will have to be manually opened or enabled for the system to run. Other valves may need to be opened or closed manually by the operators for the system to work properly.

-- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16528A

EXTERIOR LIGHTING INCLUDING SECURITY AND CCTV APPLICATIONS

-- End of Section Table of Contents --

SECTION 16528A

EXTERIOR LIGHTING INCLUDING SECURITY AND CCTV APPLICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-3	(1994) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C136.2	(1996) Luminaires, Voltage Classification Roadway Lighting Equipment
ANSI C136.3	(1995) Roadway Lighting Equipment-Luminaire Attachments
ANSI C136.6	(1997) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies -

	Mechanical and Optical Interchangeability
ANSI C136.9	(1990) Roadway Lighting - Socket Support Assemblies for Use in Metal Heads - Mechanical Interchangeability
ANSI C136.10	(1996) Roadway Lighting- Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ANSI C136.11	(1995) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.15	(1986) Roadway Lighting, High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires -

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1996) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C136.13	(1987; R 1997) Metal Brackets for Wood Poles

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Control and Systems

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connections for Use with Aluminum Conductors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1571	(1995; Rev thru Jun 1997) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting System
Detail Drawings

Detail drawings for the complete system and for poles, lighting fixtures, bracket arms. Drawings shall indicate bonding method for concrete encasement. Drawings shall include design calculations showing adequate strength of screw foundations.

a. A typical zone layout showing light locations, isolux patterns, and lighting ratios.

As-Built Drawings

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

SD-03 Product Data

Equipment and Materials

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

Spare Parts

Spare parts data for each item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

SD-06 Test Reports

Operating Test

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Ground Resistance Measurements

The measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made. The information shall be in writing.

SD-10 Operation and Maintenance Data

Lighting System

In addition to the operation and maintenance information requested in this section, see Section 01730, Facility Operation and Maintenance Manual, for additional information to be submitted for each item of equipment and each system.

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of

the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

1.3 SYSTEM DESCRIPTION

1.3.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.3.2 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.3.3 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.3.4 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.3.5 Unusual Service Conditions

Equipment and materials furnished under this section shall be suitable for the following unusual service conditions: altitude 13 feet, ambient temperature 87 degrees F.

1.3.6 Hazardous Locations

Wiring shall conform to NFPA 70 for Class I, Division 1 hazardous locations. Equipment shall be suitable for Group D operating temperature of 215 degrees F. Wiring and equipment shall be of the classes, groups, divisions indicated, and suitable for the indicated operating temperature.

1.3.7 Protection of Security Lighting System Components

1.3.7.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways or by means of direct burial, as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaries mounted below 20 feet. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

1.3.7.2 Tamper Provisions

Enclosures, cabinets, housings (other than luminaire housings), boxes, raceways, conduits, and fittings having hinged doors or removable covers, and which contain any part of the security lighting system (including power sources), shall be provided with corrosion-resistant tamper switches, connected to an Intrusion Detection System (IDS), that will initiate an alarm signal when the door or cover is opened or moved. Tamper switches shall be inaccessible until the switch is activated. Switch leads and mounting hardware shall be concealed from the exterior of the enclosure. For pull or junction boxes which contain no splices or connections the covers may be protected by 1/4 inch tack welds on four sides of each cover rather than by tamper switches. Labels shall be affixed to indicate they contain no connections. Labels shall not indicate that the box is part of the security system.

1.4 CORROSION PROTECTION

1.4.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum is connected to dissimilar metal, fittings comforming to UL 486B shall be used. Where aluminum is connected to concrete, insulating materials shall be used between the two.

1.4.2 Ferrous Metal Materials

1.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

1.4.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B

117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components. Provide product data for spare parts.

2.2 BRACKET ARMS

2.2.1 On Aluminum, Steel, Fiberglass, and Concrete Poles

Poles shall be provided with bracket arms of the davit style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.2.2 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 CABLE

The Contractor shall provide all wire and cable not indicated as government furnished equipment. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.3.1 Insulated Cable

Cable shall be as specified in Section 16415, "Electrical Work, Interior.

2.4 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.5 POLES

Concrete poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of 105 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.5.1 Concrete Poles

Concrete poles shall be designed to withstand the loads specified in IEEE C2 multiplied by the appropriate overload capacity factors. Poles shall be reinforced or prestressed, either cast or spun. Spun poles shall be manufactured by a centrifugal spinning process with concrete pumped into a polished round tapered metal mold. Concrete for spun poles shall have a compressive strength of at least 5,000 psi at 28 days; steel wire shall have an ultimate tensile strength of at least 120,000 psi; and reinforcing bars shall have an ultimate tensile strength of at least 40,000 psi. After the high speed spinning action is completed, a spun pole shall be cured by a suitable wet steam process. Spun poles shall have a water absorption of not greater than 3 percent to eliminate cracking and to prevent erosion. Concrete poles shall have hollow shafts. Poles shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost. Poles shall not be installed for at least 15 days after manufacture. Fittings and brackets that conform to the concrete pole design shall be provided. Poles shall conform to strength calculations performed by a registered professional engineer and submitted in accordance with detail drawings portion of paragraph SUBMITTALS.

2.5.2 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.6 POLE LINE HARDWARE

Zinc coated hardware shall conform to ANSI C135.1 and ANSI C135.14, and steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.7 SERIES ROADWAY LIGHTING INSULATORS

Pin insulators shall be Class 55-5. Line-post insulators shall be Class 57-1 or 57-11.

2.8 ELECTRICAL ENCLOSURES

2.8.1 Hazardous Environment Enclosures

Equipment installed in a hazardous environment shall be installed as described in paragraph Hazardous Locations.

2.9 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.9.1 High-Pressure Sodium

Lamps shall conform to ANSI C78.1351. Ballasts shall conform to ANSI C82.4, or UL 1029. High-pressure sodium lamps shall be clear.

2.10 LAMPS, INCANDESCENT

Incandescent lamps shall conform to UL 1571 and shall be rated for 12O volt operation unless otherwise specified.

2.11 LAMPS, FLUORESCENT

Fluorescent lamps shall have standard cool-white color characteristics and shall not require starter switches. The lamps shall be of the rapid-start type.

2.12 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.13 LIGHTING CONTROL EQUIPMENT

2.13.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 0.5 to 5.0 foot-candles. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

2.13.2 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.13.3 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 120 volts, single phase, 60 Hz. Coil voltage shall be 120 volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.14 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

2.15 LUMINAIRES, FLOODLIGHTING

2.15.1 HID

HID lighting fixtures shall conform to UL 1572.

2.15.2 Fluorescent

Fluorescent lamps shall conform to ANSI C78.1.

2.16 FIXTURES

2.16.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.16.2 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated at 30 amperes, 600 volts, with insulated boots. Fuse rating shall be 600 volts.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government.

Provide ground resistance measurements test reports. The Contractor shall not take any corrective action without written permission from the Government.

3.2 PREVENTION OF CORROSION

3.2.1 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.3 CABLE INSTALLATION

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each handhole and junction box, and at each terminal.

3.3.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.3.2 Installation in Duct Lines

Ground and neutral conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.4 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of 30 or 35 feet as indicated. Electrical cabling shall be provided to the light pole as specified in Section 16375. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.4.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the

mount, luminaire, and housing with wind and ice loading normally encountered at the site. Pole brackets for floodlights shall have the number of tenons indicated, arranged to provide the indicated spread between each tenon. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.4.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 3000 psi at 28 days.

3.4.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided at all poles. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 10 feet above grade.

3.4.4 Aluminum, Steel, Fiberglass and Concrete Pole Installation

Poles shall be mounted on cast-in-place or power-installed screw foundations. Concrete poles shall be mounted or embedded in accordance with the details shown. Conduit elbows shall be provided for cable entrances into pole interiors.

3.4.4.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufactures standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.4.4.2 Power-Installed Screw Foundations

Power-installed screw foundations having the required strength mounting bolt and top plate dimensions may be utilized. Screw foundations shall be of at least 1/4 inch thick structural steel conforming to ASTM A 36/A 36M and hot-dip galvanized in accordance with ASTM A 123/A 123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of any screw foundation.

3.5 LIGHTING

3.5.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.5.2 Fixture Installation

3.5.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.5.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.6 LIGHTING CONTROL SYSTEM

3.6.1 Photo-Control

Lighting luminaires shall be controlled by a single photo-control element.

3.6.2 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws will not be allowed.

3.7 GROUNDING

3.7.1 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire. Lighting fixture brackets on wood and concrete poles shall be grounded to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.8 TESTS

3.8.1 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power. Provide as-built drawings with the final test report.

-- End of Section --

NEW HYDRANT PITS

STRUCTURE NUMBER	FUEL LINE DESIGNATION	LATERAL TEE STATION	APPROXIMATE LATERAL LENGTH (FT)	RIGHT OR LEFT OF BASELINE	PIT SIDE FOR HINGE	SEE MECH DETAIL:	HYDRANT TOP ELEVATION (FT)	HYDRANT PIT INVERT (6" LATERAL) (FT)
HP-17A	LINE C1	11+07.86	35.0	RT	N	Det "A", M-26	**5.95**	1.37
HP-16B	LINE C1	18+45.99	25.0	LT	N	Det "A", M-26	**7.18**	2.60
HP-16A	LINE C1	20+92.99	25.0	LT	N	Det "A", M-26	**6.42**	1.84
HP-23A	LINE C1	27+19.57	10.0	RT	E	Det "A", M-26	**6.65**	2.07
HP-23B	LINE C1	32+51.57	10.0	RT	E	Det "A", M-26	**6.95**	2.37
HP-23C	LINE C1	37+83.57	10.0	RT	E	Det "A", M-26	**7.45**	2.87
HP-23D	LINE C1	44+23.82	10.0	RT	E	Det "A", M-26	**8.66**	4.08
HP-15A	LINE C2	29+57.45	27.2	LT	N	Det "A", M-26	**6.34**	1.76
HP-15B	LINE C2	31+73.45	27.2	LT	N	Det "A", M-26	**6.89**	2.31
HP-14A	LINE C2	38+35.80	15.0	RT	N	Det "A", M-26	**6.35**	1.77
HP-14B	LINE C2	40+60.33	25.0	LT	N	Det "A", M-26	**7.45**	2.87
HP-14C	LINE C2	42+66.33	25.0	LT	N	Det "B", M-26	**5.75**	1.17
HP-13B	LINE C2	47+09.80	10.0	RT	N	Det "A", M-26	**5.85**	1.27
HP-12B	LINE C2	51+53.31	25.0	LT	N	Det "B", M-26	**6.52**	1.94
HP-12A	LINE C2	53+59.31	25.0	LT	N	Det "A", M-26	**6.25**	1.67
HP-13A	LINE C2	58+01.85	9.0	RT	N	Det "B", M-26	**6.93**	2.35
HP-4D	LINE C3	30+90.28	20.0	LT	NW	Det "A", M-26	**7.52**	2.94
HP-4C	LINE C3	33+06.28	20.0	LT	NW	Det "A", M-26	**7.92**	3.34
HP-4B	LINE C3	35+22.28	20.0	LT	NW	Det "A", M-26	**6.37**	1.79
HP-4A	LINE C3	37+28.98	15.0	LT	NW	Det "A", M-26	**6.35**	1.77
HP-3A	LINE C3	41+86.90	19.2	RT	NW	Det "B", M-26	**6.75**	2.17
HP-3B	LINE C3	44+41.36	30.0	RT	NW	Det "A", M-26	**6.85**	2.27
HP-3C	LINE C3	46+57.36	30.0	RT	NW	Det "A", M-26	**7.90**	3.32
HP-3D	LINE C3	48+73.36	30.0	RT	NW	Det "A", M-26	**7.30**	2.72
HP-2D	LINE C4	0+80.04	25.0	RT	NW	Det "A", M-26	**7.35**	2.77
HP-2C	LINE C4	2+96.04	25.0	RT	NW	Det "A", M-26	**8.45**	3.87
HP-2B	LINE C4	5+12.04	25.0	RT	NW	Det "A", M-26	**7.15**	2.57
HP-2A	LINE C4	7+61.35	9.7	RT	NW	Det "B", M-26	**7.24**	2.66
HP-1A	LINE C4	12+11.36	9.7	RT	NW	Det "B", M-26	**7.38**	2.80
HP-1B	LINE C4	14+74.38	25.0	RT	NW	Det "A", M-26	**7.65**	3.07
HP-1C	LINE C4	16+90.38	25.0	RT	NW	Det "A", M-26	**8.55**	3.97
HP-1D	LINE C4	19+06.38	25.0	RT	NW	Det "A", M-26	**7.38**	2.80

Attachment to Standard Form 30, Paragraph 2, Changes to Drawings, Item No. 23. (Am-0006)

NEW HIGH POINT VENTS					
STRUCTURE NUMBER	FUEL LINE DESIGNATION	FUEL MAIN STATION	SEE MECH DETAIL:	TOP ELEVATION (FT)	FUEL MAIN INVERT (FT)
HPV-1	Line C-1	7+54.69	Detail "E", M-28	**5.48**	-1.31
	Line D-1	33+80.00			
HPV-2	Line C-1	18+15.00	Detail "B", M-28	**6.91**	0.73
HPV-3	Line C-1	32+25.00	Detail "E", M-28	**6.95**	1.35
	Line C-2	12+09.12			
HPV-4	Line C-2	32+10.00	Detail "B", M-28	**7.05**	0.10
HPV-5	Line C-2	52+75.00	Detail "B", M-28	**7.05**	1.00
HPV-6	Line C-3	11+90.00	Detail "A", M-28	5.90	0.71
	Line D-1	6+05.00			
HPV-7	Line C-3	27+00.00	Detail "B", M-28	**7.02**	1.04
HPV-8	Line C-3	39+70.00	Detail "B", M-28	**6.45**	-3.17
HPV-9	Line C-3	47+50.00	Detail "B", M-28	**7.95**	1.39
HPV-10	Line C-4	10+00.00	Detail "B", M-28	**7.45**	2.07
HPV-11	Line C-4	16+00.00	Detail "B", M-28	**8.40**	2.22
HPV-12	Line D-1	14+00.00	Detail "B", M-28	**6.65**	1.72
HPV-13	Line D-1	18+50.00	Detail "A", M-28	5.37	-0.47
HPV-14	Line D-1	27+00.00	Detail "B", M-28	**6.55**	1.03
HPV-15	Temp	1+98.00	Detail "A", M-28	6.40	1.50

NEW LOW POINT DRAINS					
STRUCTURE NUMBER	FUEL LINE DESIGNATION	STATION	SEE MECH DETAIL:	TOP ELEVATION (FT)	FUEL MAIN INVERT (FT)
LPD-1	Line A-1	7+40.48	Detail "D", M-27	5.80	-2.55
	Line A-2	6+54.13			
	Line A-3	8+12.29			
	Line A-4	7+27.09			
LPD-2	Line A-3	4+62.77	Detail "C", M-28	6.80	0.74
LPD-3	Line B-1	2+75.00	Detail "D", M-28	5.46	-5.06
LPD-4	Line C-1	3+50.00	Detail "C", M-28	4.54	-2.93
	Line D-1	37+85.00			
LPD-5	Line C-1	12+75.00	Detail "D", M-28	**6.05**	-5.80
LPD-6	Line C-1	24+00.00	Detail "D", M-28	**6.18**	-2.78
LPD-7	Line C-1	38+00.00	Detail "E", M-28	**7.65**	0.20
	Line C-2	6+34.12			
LPD-8	Line C-2	21+25.00	Detail "E", M-28	**5.84**	-2.55
	Line D-1	23+42.00			
LPD-9	Line C-2	43+75.00	Detail "D", M-28	**5.65**	-5.87
LPD-10	Line C-3	3+70.00	Detail "C", M-28	6.30	-4.43
LPD-11	Line C-3	18+50.00	Detail "D", M-28	**7.06**	-3.06
LPD-12	Line C-3	36+10.00	Detail "D", M-28	**5.95**	-4.61
LPD-13	Line C-3	43+50.00	Detail "D", M-28	**6.25**	-4.31
LPD-14	Line C-4	13+66.00	Detail "D", M-28	**7.07**	-2.46
LPD-15	Line D-1	1+00.00	Detail "D", M-28	**7.05**	-2.83
LPD-16	Line D-1	12+18.00	Detail "D", M-28	**7.14**	-2.83
LPD-17	Line D-1	17+00.00	Detail "C", M-28	5.45	-4.12
LPD-18	Line D-1	31+25.00	Detail "D", M-28	**4.75**	-5.21
LPD-19	Temp	3+59.00	Detail "C", M-28	6.20	0.50

NEW ISOLATION VALVE PITS					
STRUCTURE NUMBER	FUEL LINE DESIGNATION	FUEL MAIN STATION	SEE MECH DETAIL:	TOP ELEVATION (FT)	FUEL MAIN INVERT (FT)
IVP-1	LINE C1 / C2	44+99.87	Detail "C", M-26	**9.27**	3.70
IVP-2	LINE C2 / C3	62+30.29	Detail "C", M-26	5.30	-0.91
IVP-3	LINE C3 / C4	53+60.14	Detail "C", M-26	**7.16**	0.17

Attachment to Standard Form 30, Paragraph 2, Changes to Drawings, Item No. 23. (Am-0006)

IVP-4	LINE B1	5+12.57	Detail "C", M-26	**7.02**	2.28